

REPORT
OF THE
COMMISSIONERS
ON
FISHERIES AND GAME
FOR THE
YEARS 1912, 1913 AND 1914.

By: Belding, David L.:

The report of the biologist of the Commission

Page 78

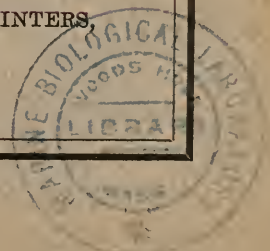


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32 DERNE STREET.

1916.



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1916.

APPROVED BY
THE STATE BOARD OF PUBLICATION.

COMMISSIONERS ON FISHERIES AND GAME.

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¹ Term expired 1913.



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The Commonwealth of Massachusetts.

To His Excellency the Governor and the Honorable Council.

The Commissioners on Fisheries and Game respectfully submit their forty-seventh, forty-eighth and forty-ninth annual reports.

GENERAL CONSIDERATION.

Attention is again called to the peculiarly favorable opportunities for intensive utilization of latent food-producing resources. It is reasonable to state that few departments of government reach so directly and intimately the vital interests of all the people as does the department of fisheries and game, not alone as stimulating recreative and health-producing sports, but even more by assisting in the annual production of important food. Fresh-water fish, birds and game are peculiarly responsive to correct methods of artificial propagation. Similarly, methods for increasing production must be applied to the salt-water fisheries and other natural resources of the Commonwealth.

With these factors constantly in mind your commissioners seek to administer the department, to the end that a maximum efficiency may be reached at a minimum cost, so far as enlightened public opinion and available resources permit. Each year the requirements for fish and game protection and propagation are becoming more complicated as a result of the increasing diversity of public interests, as reflected by new laws and demands for greater production. A definitely planned system for all branches of the department seeks to meet and even to anticipate these growing demands. Some of the chief points in the work of the commission during the past three years, and suggestions for future development, are presented in this report.

Marine Fisheries.

For nearly three hundred years the waters of our coast have proved a veritable bonanza, not alone for the fishermen but also for the food-consuming public. In the past these coastal waters have been remarkable in the large variety and almost inconceivable quantities of commercial fish, such as codfish, mackerel, pollock, halibut, bluefish, striped bass, shad and herring. We have, however, unwisely devoted excessive attention to the exploitation of these fish for the purpose of providing food, and have thereby permitted an undue increase in the destructive species, notably the dogfish and shark. Owing to the unintelligent destruction of the more "fashionable" fish, it will probably soon be necessary to utilize the less desirable species, to some extent, as food, and certainly for fertilizer and oil. Further, we must deal with the fisheries in such a manner that the destruction of adults may not seriously diminish the aggregate number of eggs produced annually by any species. The principles of economic biology must be applied to the fisheries in the same manner as they have been used to secure satisfactory agricultural conditions on land.

Mollusk Fisheries. — The land under the waters must be intensively cultivated in order to insure increased production as well as a just distribution of the rewards of labor. The utilization of our coastal flats is destined to pass through the same stages of developmental evolution as our farming lands, which were formerly held in common, but which, after the requirements for increased food production made necessary individual initiative and control, passed into the hands of private owners. The natural change from communism to individual ownership came at a period when the amount of land available was sufficient to meet normal requirements, and was in accordance with ancient legislative acts. A similar situation now exists with our coastal waters. The right of fishing for certain fish and shellfish is the last remnant in Massachusetts of that primitive communism which on land was so unsatisfactory to our ancestors. We believe that the land under water, except such portions as may be set apart for public use, should be leased by the State to individuals for a limited period

of years, on terms which should insure to every citizen a just opportunity to share in these natural resources, and inasmuch as this is a public right, the moneys derived from rentals should go into the State treasury.

Our flats produce many varieties of food and bait mollusks, and certain foreign species may be introduced to great advantage. Waiving the possible difference of opinion as to what constitutes a natural bed of mollusks, we are entirely justified in saying that there no longer exists in Massachusetts waters a really productive natural bed of any species of food mollusks the yield of which could not be enormously increased under well-managed artificial cultivation. If all areas under water should be utilized ultimately to the highest degree possible, a very appreciable contribution would be made toward decreasing the cost of living.

The most prominent changes during the past three years have been in the clam, oyster and quahaug fisheries. Commercial clam culture has been started on a relatively large scale at Plymouth and Barnstable, with extremely satisfactory results. The development of the oyster business has increased, while a bed of quahaugs has been discovered off Nantucket, where this mollusk is taken by dredging. However, owing to the inadequate facilities for distribution, the yield has locally reduced the price of quahaugs, to the benefit of a few near-by consumers and to the disappointment of the fishermen.

Lobster Fishery. — The decline of the lobster fishery still continues in spite of the purchase of egg lobsters, and if the lobster is to be saved it is evident that additional measures must be imposed, not only by the State but by the Federal government. It is a pleasure to report that the Massachusetts lobstermen are attempting to preserve the fishery by forming associations, the principal aim of which is to return "egggers" and "shorts" and to set apart portions of the fishing grounds as refuges, where, by mutual agreement, no fishing is allowed. The chief necessity is a greater annual production of eggs and their development to lobsters of marketable and breeding size. Our suggestions, which comprise added protection to adults and young below the optimum marketable size, measurement on the carapace, licensing of fishermen and dealers as a means for

practical enforcement of law, and Federal supervision of interstate shipments, are urged as necessary to safeguard the public interests in the lobster fisheries, and as a basis for uniform laws in the North Atlantic States and provinces.

Coastal Streams. — The fisheries of our coastal streams have been severely abused. Within the memory of men now living shad were so numerous in the Connecticut River that they were used for fertilizer. The shad fishery is now confined to only three Massachusetts rivers, where a relatively small number is taken. Trout have been practically exterminated, except where maintained by artificial propagation. Owing to overfishing and unwise legislation our bountiful alewife and smelt fisheries now yield less than a tithe of their former abundance. These latter fisheries are not only valuable in themselves, but also indirectly serve to attract to our shore more valuable food fish, such as mackerel, bluefish, pollock and others. The cause of this diminution has been the system of leasing the streams by the towns to the highest bidder, and their extensive use as public and private sewers or reservoirs for manufacturing wastes, thus not alone destroying the breeding ground but also driving away the adult fish, as is the case, for example, with the Merrimack, Charles and Mystic rivers. Fortunately, these abuses can be corrected by legislative action through the intelligent co-operation of the public. As a result of a thorough study of the conditions in the alewife and smelt streams, methods of reclaiming the valuable fisheries can be readily applied, and these streams may again become an important asset to the Commonwealth, provided suitable laws are enacted. The need of Federal and State control is decidedly apparent, owing to the mismanagement of certain towns and their refusal to lease under conditions favorable for improving the fisheries; for example, the Marston Mills Herring Brook, Weweantit River, and of late years the Mattapoisett River.

Otter Trawl. — The increasing use of the small otter trawl in the shore fisheries presents a different problem from the deep sea or large otter trawl. The beam trawl in shore fishing has been largely supplanted by the small otter trawl, and in certain localities excessive fishing has resulted in the depletion of the

supply of flatfish. The fleet of large otter trawlers operating upon Georges and other fishing banks indicates that this type of fishing has come to stay, and, when conditions have become properly adjusted, it promises mutual advantage to both fishermen and consumers.

Buzzards Bay — For two years an investigation of the fisheries of Buzzards Bay has been carried on, with special reference to trap fishing. Data bearing upon these fisheries have been collected, and it is hoped that a definite solution of the problem may result after sufficient time has been allowed for the completion of adequate statistics. Unfortunately, the legislative act authorizing this investigation carried with it no appropriation after the first year, thereby limiting the scope of the work to the collection of statistics from a few fishermen who are given the privilege of establishing fish traps. Under such unsatisfactory conditions it will be difficult to make adequate recommendations such as a thorough and complete investigation would have permitted.

Inland Fisheries.

Within the past three years definite scientific steps have been taken to restore the fisheries in the inland ponds and streams to some semblance of their original productiveness. To correct the abuses of nearly three hundred years will necessarily be a long and seemingly expensive process, especially while the economic blunder of polluting these streams still continues.

Fishways. — The problem of providing suitable fishways, particularly in the salmon, shad and alewife streams, has received the attention of your commissioners, and several fishways have been installed or improved under their direction.

Water Rights. — It is eminently desirable that the various water and stream rights be more clearly defined, particularly the fishery rights of riparian owners, which should be controlled and regulated by the State. Such action would be of great assistance to your commissioners in handling various fish problems.

Pond and Stream Survey. — A biological examination, described in greater detail in another section of this report, has

been made of all the State ponds and streams in the Commonwealth for the purpose of developing a systematic and efficient method of fish distribution.

Pollution. — The pollution question is daily becoming a more important factor. Many of our finest streams and their tributaries, viz., the Merrimack, Connecticut, Housatonic and Charles rivers, have suffered severely by the misuse of manufacturing wastes and sewage. During the past three years two hundred and seventy-six cases of pollution have been examined, and such action as is consistent with present laws taken. It is highly desirable that a complete survey of the pollution of our inland waters be made, and that more suitable and workable preventive laws be enacted.

Hatcheries. — Many varieties of edible fish are well adapted for economical production by artificial methods. During the past three years the State has come into control of two valuable hatchery sites, at Sandwich and Palmer, each of which is now in process of development along definite lines. These hatcheries will enable the State to produce fish at a handsome profit, as compared with the average private hatcheries. At the present time brook, brown and rainbow trout, chinook salmon, yellow and pike perch, and black bass are raised and distributed from well-equipped hatcheries at Sutton, Sandwich, Palmer and Adams.

Game.

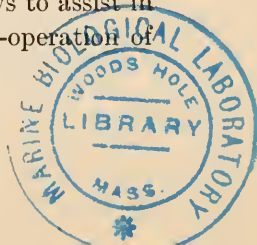
Long ago the fact was demonstrated that not only can man assist nature, but that he can far surpass her natural unaided efforts. Massachusetts was a pioneer in the artificial hatching of trout, and the value of similar experimentation in connection with birds and quadrupeds has been proved. To carry on this work on a broad, practical scale requires a reasonably elaborate plant. Our general system includes hatcheries, rearing stations and game farms for breeding birds, and reservations to attract and maintain wild birds and game, where special efforts are made to provide food, shelter, breeding places and freedom from enemies. Especially for the solution of the game bird problem is this work of great value.

Game Farms. — During the past three years five new game-rearing plants, at Wilbraham, Sandwich, Marshfield, Sharon and Norfolk, have been established, and the efficiency of the Sutton game farm has been increased by the enlargement of the yards and the establishment of a laboratory for the investigation of bird diseases. At these farms pheasants, quail (bob-white) and mallard ducks are being extensively raised, while ruffed grouse, wild turkeys and various species of ducks are being bred experimentally. From these farms are annually distributed large numbers of pheasants, quail and ducks for the coverts of the Commonwealth.

Reservations. — In addition to the heath hen reservation on Martha's Vineyard, a number of reservations have been established under chapter 410, Acts of 1911, and more are under consideration. This law gives a group of landowners or the selectmen of towns the right to petition the commissioners to close certain areas against shooting. On these tracts trespassing and shooting are prohibited for periods of not more than five years, and the birds and quadrupeds are given an opportunity to increase under natural conditions. The policy of this department is to place under the provisions of this act those areas which have been or now are depleted, with the hope of restoring the natural supply.

National Activities. — Your commissioners have not merely confined their activities to Massachusetts, but have been prominent in national problems relating to fish and game, and have held or now hold responsible positions as president or vice-president in organizations such as the National Association of Shellfish Commissioners, the American Fisheries Society, the National Conservation Congress and the National Association of Game and Fish Commissioners. Activities of this sort are for the best interests of the Commonwealth, and add to the prestige of Massachusetts.

State Associations. — Every encouragement has been given to the fishermen and gunners of the Commonwealth to form associations. The commissioners have been interested in the formation of new associations, and have been ready always to assist in any way within their power. It is through the co-operation of



such associations that the best results in the enforcement of the fish and game laws, the most effective distribution of the annual output of fish and game, and the education of the rank and file to more advanced ideas of conservation can be achieved.

Migratory Bird Law. — The Federal regulations for the protection of migratory birds, approved by the President Oct. 1, 1914, marks a decided advance in bird protection. The provisions of this act apply in Massachusetts except when the Massachusetts laws are more limited, *i.e.*, a shorter season. In such instances the Massachusetts law takes precedence. In another year we may be able to report the effects of this law upon Massachusetts birds.

Heath Hen. — Marked improvements have been made during the past two years on the reservation on Martha's Vineyard, and up-to-date facilities, particularly in fire prevention, are at hand for caring for the heath hen, which, ten years ago numbering less than fifty, have increased to over one thousand.

Hunters' Licenses. — The great increase in the number of licenses issued during 1914, producing a revenue of \$64,966.85 to the Commonwealth, as compared with \$50,497.30 for 1912, speaks well for the system. The money derived from this source should rightly be invested in the propagation of game.

Educational Exhibitions.

Your commissioners have endeavored to interest the public in fish and game conservation by exhibiting live birds and fish as reared at the hatcheries at the agricultural fairs and at other exhibitions at Boston, Barnstable, North Adams, Mansfield, Northampton, Fitchburg, Palmer and Worcester, where live trout, salmon, perch, ducks and pheasants proved centers of attraction. In addition, a number of stereopticon lectures have been given in different parts of the State.

Organization.

In addition to the three commissioners, on Nov. 30, 1914, the department had 87 officials and employees who were organized into an office force and thirteen other groups or divisions, each of which was in charge of an official directly responsible to the

commissioners. The number of employees in each group, including temporary assistants and day laborers, are shown in the following summary: —

Commissioners,	3
1. Clerks and stenographers,	9
2. Biologist and assistant,	2
3. Division for enforcement of law,	31
4. Wilbraham game farm,	3
5. Sutton hatchery,	8
6. Palmer hatchery,	18
7. Sandwich hatchery,	6
8. Sandwich hatchery (bird farm),	2
9. Adams hatchery,	1
10. Martha's Vineyard reservation,	3
11. Sharon reservation,	1
12. Marshfield reservation,	1
13. Norfolk State Hospital reservation,	1
14. Hadley hatchery (not in use),	1

90

Central Office. — In addition to such administrative work as is performed by the commissioners, the office work consists of routine clerical and stenographic work, keeping records and accounts, and the receipt of revenue from hunters' licenses issued by city and town clerks. The office force comprises a chief clerk, a bookkeeper, two permanent and one temporary stenographers and an office boy.

Enforcement of Law. — The force employed on the enforcement of law comprises a chief deputy, twenty-seven State district deputies, four special deputies and six superintendents of State fish hatcheries and game farms who are commissioned to serve as deputies in making arrests and in otherwise enforcing the laws. A weekly narrative report is submitted by each deputy, in which a description of each day's work is given, including the time at which the deputy left home and returned, the places visited by him and the names and license numbers of hunters interviewed. The management of the district deputies

is vested in the chief deputy, who has his headquarters at the commission's office in the State House. Cities and towns also have local town wardens for the enforcement of law in their several localities, and in addition there are a number of unpaid deputies who do volunteer service. The city and town game wardens, who have powers and duties identical with the State deputies, are appointed by the Commissioners on Fisheries and Game upon written application made by the city government or the selectmen of a town. The annual compensation, not exceeding \$50, is paid by the city or town by which he is appointed. Each local warden is required to submit a weekly narrative report similar to that made by the State district deputies.

Scientific Investigation. — The various problems relating to fish and game, especially concerning the practical work of the commission, are investigated by the biologist under the general direction of the commissioners. Temporary assistants, as the investigations demand, are hired by the month. Various scientific reports recording the results of these investigations are submitted from time to time. During the past three years, in addition to routine work the biologist has given special attention to (1) mollusk fisheries, (2) trap fishing, (3) the alewife fisheries, (4) examination of inland waters, both ponds and streams, and (5) bird diseases.

Propagation of Fish and Game. — At each of the following stations, except Sharon and Marshfield, the Commonwealth owns land and buildings, and at Sandwich, Martha's Vineyard, Palmer and Wilbraham additional land is rented. The State operated for several years a hatchery at Hadley, but this station was discontinued because of an unsatisfactory water supply. The property at Hadley is now for sale, as authorized by chapter 49 of the Resolves of 1912. Likewise, the commissioners are authorized, by chapter 410, Acts of 1911, to establish additional State bird and game preserves, and to co-operate with landowners in the propagation of birds and quadrupeds for the benefit of the public.

STATION.	Date Estab- lished.	Output.	Superintendents.	ASSISTANTS.	
				Per- manent.	Tem- porary.
Sutton,	1892	Fish and game.	Arthur Merrill, . . .	3	3
Adams,	1898	Fish, .	Henry Sheldon, . . .	—	—
Martha's Vineyard, . .	1907	Game, .	William Day,	—	2
Palmer,	1912	Fish, .	Otis Munroe,	2	5
Sandwich,	1912	Fish, .	F. E. Hithings, . . .	3	2
Sharon,	1912	Game, .	F. R. Cushing,	—	—
Wilbraham,	1912	Game, .	Joseph H. Mosher, . .	1	2
Norfolk,	1913	Game, .	W. W. Gates,	—	—
Marshfield,	1914	Game, .	Lysander B. Sherman, .	—	—
East Sandwich,	1914	Game, .	H. A. Torrey,	—	1

Finances.

Receipts and Expenditures of the Fish and Game Commission during the Years 1912, 1913 and 1914.

	1912.	1913.	1914.
<i>Receipts.</i>			
Nonresident hunting licenses (\$10 each),	\$1,018 45	\$1,532 00	\$1,264 70
Nonresident hunting licenses (\$1 each),	84 80	125 65	137 20
Resident hunting licenses (\$1 each),	47,886 40	51,963 45	61,192 25
Alien hunting licenses (\$15 each),	1,507 65	1,820 70	2,372 70
Total,	\$50,497 30	\$55,441 80	\$64,966 85
Sale of lobsters to United States government, . .	\$209 85	—	—
Sale of game tags,	—	\$995 95	\$561 70
Interest on bank deposits,	29 35	31 46	41 95
Leases of clam flats,	55 00	—	—
Forfeitures,	2 35	133 10	68 80
Refunds,	3 40	—	—
Sale of launch,	—	200 00	—
Sale of fish (chapter 44, Resolves of 1914), . .	—	—	319 12
Total,	\$299 95	\$1,360 51	\$991 57
Yearly totals,	\$50,797 25	\$56,802 31	\$65,958 42
<i>Expenditures.</i>			
Commissioners' salaries, clerical services, travel and office expenses,	\$13,589 67	\$14,286 89	\$16,590 77
Enforcement of law, maintenance of hatcheries and lobsters,	62,421 53	74,860 38	78,088 51
Establishment of fish hatcheries and cultivation of food and game fish,	19,968 68	17,703 49	13,185 23
Establishment of game farms and propagation of birds and game,	14,418 63	19,192 74	27,688 31
Investigations,	1,273 34	2,499 94	206 47
Total,	\$111,671 85	\$128,543 44	\$135,759 29

No fees have been received for the inspection of fish in accordance with the provisions of chapter 138, Acts of 1912.

The following statement shows to what extent the Commission on Fisheries and Game has been self-supporting during the past six years: —

Total of general and special appropriations,	\$587,430 00
Cash turned into State treasury, exclusive of fines and forfeitures: —	
For the past six years,	\$279,603 92
Unexpended balances returned to Treasurer,	14,186 25
Present value of real estate and equipment acquired since 1909,	80,547 00
Total of fines, forfeitures, etc.,	29,423 00
	<hr/>
	\$403,760 17
Value of output of fish and birds for past six years, at time put out,	125,127 50
	<hr/>
	528,887 67
	<hr/>
	\$58,542 33
Annual net cost,	\$9,757 05

LEGISLATION.

Each year there is evident a commendable disinclination on the part of the Legislature to encumber further the statutes with special legislation, and attempts are made to simplify the fish and game laws. There has developed a sturdy, beneficial opposition to ill-advised, special regulations, which tends to make the laws more intelligible to the average citizen and greatly facilitates proper enforcement. The fish and game laws have too important a bearing upon the prosperity of the country to allow unintelligent and hasty formulation of regulations or injudiciously rigorous or lax enforcement of the laws.

In general the fish and game laws are made (1) for the maintenance and proper utilization of the natural yield of fish and game; (2) for the farmer and fisherman, who deal first hand with these products; (3) for the general public, to whose continued well-being fish, flesh and fowl contribute no insignificant degree; and (4) for those persons not citizens of the State who nevertheless derive benefit from the public supply of fish and game.

The most difficult laws to enforce satisfactorily belong to the first group. Fishermen and hunters, too often impelled by selfishness, notoriously destroy in order that another may not secure the booty. Many lobster fishermen openly say that when the lobster is gone they will take up some other kind of fishing. Similarly, any regulation to protect the breeding fish, birds or mammals is met with strenuous opposition from men who object to any interference with their own practice or convenience. Yet there is an ever-growing necessity for intelligent restrictions in fish and game protection.

The farmer and the fishermen have legitimate rights which the State must recognize. The prosperity of the community rests ultimately upon agriculture; and therefore the birds must be protected in order that the ravages of insects and the noxious weeds may not impose too great a burden upon agriculture, thus increasing the cost of food production. The wild fox, cat, dog and other animals must not be permitted to destroy our birds or poultry. The respective interests of the various members of the community in rabbits and deer, both of which may injure rural property, must be regulated with intelligence and justice. The rights of the farmer to the products of his labor must be protected, and, similarly, the rights of the laboring man and of the leisure class to participate in the enjoyment of fishing and hunting, without serious prejudice to the welfare of others, must be recognized. Unfortunately the rights of the State and general public often appear directly opposed to one or more classes of the community, but in such cases the public interest must be paramount. The highest courts have decided that the wild fish, birds and mammals are the property of the State and cannot be converted or reduced to private possession except under such definite regulations as the Legislature of the State may enact.

Towards the people who are not citizens of the State a minimum discrimination must be made in order to secure to tax-paying citizens their just benefits. Such instances are the laws restricting hunting by unnaturalized, foreign-born persons, which even in their present imperfect form have been of much benefit, and the regulation compelling nonresidents to take out hunting licenses.

The cause of fish and game protection suffers primarily from a conspicuous lack of a broad foundation of fact. Only too often personal opinions, based on faulty or incomplete observations, have brought about ill-advised legislation. For the solution of the problem a careful and scientific analysis of facts is essential. We must know more about the life history of birds and animals, the interdependence of the various species of animals and plants, and the peculiar diseases which affect fish and game. We must study reasonably accurate records of each species. The number of hunters, the productive capacity and condition of the areas hunted and unhunted, and the effects of an increasing population must be known. Records of such prominent facts would surely furnish some substantial basis for intelligent legislative action. The preceding generation ridiculed as vague, theoretical and impractical a similar biological study of agricultural operation, but the substantial results already secured by the department of agriculture are of exceeding value to the present generation. The hunters' license system is but the beginning of an undertaking which will ultimately furnish similar information for the better utilization and conservation of our fish and game. Massachusetts has for many years required the commercial fishermen to make sworn statements relative to their annual catch, not for the purpose of unnecessarily restricting the catch, but to secure information for intelligent legislation. Licensed sportsmen can even more effectually co-operate with the department of fisheries and game by rendering a truthful statement of the birds and quadrupeds killed, in this way furnishing a large volume of useful data, which in due time would become available for improving conditions.

Enforcement of Law.

The enforcement of the fish and game laws forms an important branch of the activities of this department, the cost approximating one-third of the total appropriation. The statutes contain a large number of provisions relative to the protection and taking of fish and game, including many special statutes for particular localities, the enforcement of which, owing to their complicated and even contradictory nature, necessitates considerable expense and labor. Generally speaking,

these laws prescribe the places, time and kind of fish and game which may be legally taken.

Proper enforcement of these laws is especially difficult. The fundamental obstacle is the lack of proprietary interest and personal responsibility similar to that which the farmer has in his crops. The general feeling of a hunter or fisherman is too often embodied in the idea, "if I don't kill it some one else will, and I might as well have it as let the other fellow." There are three distinct types of violation: (1) congenital inability to comprehend the law; (2) carelessness or neglect to consult the statutes; and (3) the violator who expects to pay the penalty of court but is willing to take a chance when the odds are in his favor. The violators again fall into two classes, the occasional and the professional. It is the duty of our wardens to inform, warn and to a certain extent educate the ignorant. The other two classes must be held strictly accountable to the letter of the law, both for its individual and general effect, since publicity is of value with individuals as well as with corporations.

The fish and game laws, unlike most other types, are broken in relative or complete solitude, or in parties where all are culpable or bound by ties sentimental or otherwise. On this account evidence is difficult to obtain, and the difficulty is accentuated by the fact that the booty, *e.g.*, meat, feathers, fur, etc., is disposed of with relative ease.

The people who adversely criticise most freely are those who have the least practical knowledge. Our hardest "knockers" are those who sit in their offices and listen to indefinite stories. It is exceedingly hard to find a man who is willing and able to make an accurate and adequate statement concerning specific violations upon which a court case may be successfully prosecuted. Recently the use of the automobile has contributed to the difficulty of game law enforcement. Anti-sale and bag-limit provisions are susceptible of facile infraction. License laws, although they have done much to aid in identification of hunters, are evaded in several ways in spite of reasonably rigid inspection. Attempts are frequently made to use the membership in fraternities, orders, clubs, etc., to avert arrest in cases of minor infraction, or to secure special privileges.

The mechanism of enforcing fish and game laws renders it

impossible to give full justice to the efficiency of this active department. While highly desirable to give publicity to all our activities, it is obviously impossible to take the public into confidence in all cases relating to the enforcement of the law, as the effective work of the department depends primarily upon the secrecy and celerity with which it is accomplished. Therefore it is not uncommon to have numerous complaints concerning the lack of efficiency of certain deputies, owing to the fact that the general public does not understand or appreciate the amount of work which is being carried on in each district. Our deputies only disclose their identity when absolutely necessary in the quiet and thorough performance of their duties. Delays occasionally occur when a deputy cannot leave one case to take up another concerning which information has been received.

The work of the game warden does not necessarily consist in making numerous arrests, but rather in so organizing his district that violations of the fish and game laws are made more difficult on account of fear of detection, and also by guiding the sentiment of his community toward a proper appreciation of their importance. Too often the violations of these laws have been considered not on a par with other criminal acts, and citizens, law abiding in all other particulars, have not considered it beneath their dignity to violate laws made for the protection and preservation of fish and game life. However, we are pleased to note that there has been a decided change in public sentiment in regard to such laws, and the violator is no longer considered a semi-hero, but is relegated to his proper sphere, that of a petty, contemptible lawbreaker. The ultimate conservation of our fish and game depends upon an enlightened public sentiment, as it is manifestly impossible, with the limited facilities at our disposal, adequately to enforce the laws unless amply supported by public approval.

The condensed report of Chief Deputy Bourne concerning the activities of his department during the past three years follows:—

Boston, Mass., Dec. 1, 1914.

Commissioners on Fisheries and Game, State House, Boston, Mass.

GENTLEMEN: — I herewith submit my summarized report for the three years ending Dec. 1, 1914.

On Nov. 20, 1911, I was appointed special assistant to Chief Deputy W. W. Nixon, and upon his untimely death, Feb. 8, 1912, was promoted to the position of chief deputy. The greater portion of my time during the past three years has been devoted to office work necessary to direct the activities of the deputies, investigations of special complaints of law infraction, superintending the distribution of fish, and handling the large amount of correspondence directly relating to the enforcement of fish and game laws.

District Deputies. — In 1912 the force consisted of 29 paid deputies and 4 special deputies who were hired during the open season. In 1913 there were the same number of deputies and 4 special deputies whose terms expired in September. The only change during the year was the transfer of Deputy Charles L. Savery, who returned at the end of the year, from Martha's Vineyard reservation to special work in Plymouth and Barnstable counties, his place being taken by Deputy William Day. In 1914 the force consisted of 27 district deputies and 4 special deputies. A new system, which has already demonstrated its value, was inaugurated by the appointment of George W. Piper as deputy at large, to be sent wherever assistance was needed in the enforcement of the law or in the distribution of fish.

Civil Service. — The admission of deputies under civil service regulation has proved a valued stimulus in the apprehension of violators, both rich and poor, owing to the added protection given to the position of deputy. On July 1, 1914, over one hundred candidates appeared before the Civil Service Commission for examination. Temporary appointments of men certified by the Civil Service Commission were made for the balance of the year as follows: Edward E. Backus, Jr., of Interlaken; William H. Seaman of Fall River; Orrin D. Steele of Byfield.

Needs of the Force. — The need of more district deputies is pressing. It is manifestly impossible in certain districts for the deputy to cover his territory in a thorough manner, and this condition can be met only by an increased number of men and better means of transportation. An increased force means more results, not only in arrests but in the more important prevention of violations. The increased number of birds and fish to be distributed each year, the many additional laws on the statute books restricting hunting and fishing, and the increased number of hunters and fishermen, all render a larger force imperative.

Special Deputies. — In addition to the district deputies special wardens are appointed at such times as occasion demands. These men serve as regular deputies, but only for certain months. It had been customary, before the advent of civil service regulations, to consider the force of unpaid deputies as a training school from which were appointed the

regular district deputies. Under the new system this training school has been modified only as the certified appointees are first made special deputies before they are appointed to positions as district wardens.

Town Wardens. — Recently an effort has been made to strengthen the deputy force by the appointment of town wardens to aid the district deputies. One man is appointed to a town or city under the present law, on request of the mayor and aldermen or selectmen, and may receive \$50 per year for protecting the fish and game. In this way it is hoped to build up an efficient working system of law enforcement. These men assist the district deputy, and make possible more adequate control of his district. The system is as yet in its infancy, as but 30 cities and towns have taken advantage of this act, but those wardens who have been appointed have thoroughly demonstrated their willingness, interest and efficiency in a manner which augurs well for its ultimate success.

Unpaid Deputies. — The system of unpaid deputies, in force for a number of years in this department, is gradually being eliminated, owing to its lack of efficiency. In the light of actual results little has ever been accomplished by this method of law enforcement. The failure of this system was largely due to the inefficiency and lack of interest on the part of the majority of unpaid wardens. This lack of interest was manifest on the repeal of the law permitting the warden making a conviction to receive a moiety of the fine. Many of the unpaid deputies who are retained at the present time are leading citizens in their respective communities, and being well posted in fish and game matters are willing to make great personal sacrifice for the good of the cause in the interests of citizenship. The Commonwealth has profited much by services of this type, and it is eminently desirable that such men be retained, while the other class, who seek merely special personal privilege, be eliminated.

Assaults. — Several cases of assaults upon deputies have been brought before the courts. In each instance a substantial fine was imposed. The most notable occurred on Dec. 23, 1913. A deputy was struck on the head with a loaded shotgun in the hands of a Rhode Island hunter of national reputation as a crack shot and so-called sportsman. The gun was discharged and a hole blown through the side of the barrel, severely wounding the deputy. The case was finally tried before a jury and a fine of \$1,000 was paid. The other assaults were made by unnaturalized foreigners.

Violations of Fish and Game Laws.

	1912.	1913.	1914.	Total.
Number of cases,	531	604	540	1,675
Number of cases discharged,	36	61	43	140
Number of cases convicted,	495	538	488	1,521
Number of cases appealed,	26	27	44	97
Number of cases filed,	110	103	69	282
Fines imposed,	\$5,890 00	\$6,652 00	\$6,551 40	\$19,093 40
Fines paid,	5,199 00	5,701 00	4,801 40	15,701 40
Costs of court,	128 82	106 74	34 88	270 44

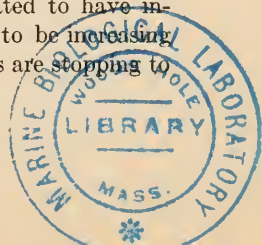
Automobile. — Automobiles and fast power boats render imperative some speedy method of transportation for deputies, both upon land and water. A man on foot is under too severe a handicap to catch gunners in a modern high-power touring car, which rapidly carries violators from one section to another, and in the same manner a man in a dory is powerless to overhaul a speedy motor boat. Undoubtedly much of the illegal work now conducted from automobiles and power boats would cease if these violators realized that the deputies were in a position to overtake them.

Registration of Hunters. — Chapter 614 of the Acts of 1911, as amended by chapter 397 of the Acts of 1912, provided for the licensing and registration of hunters. This act required that every hunter should secure a license from a town or city clerk at the cost of \$1. There are four classes of registered hunters: (1) the nonresident, with a charge of \$10; (2) the nonresident owner of real estate assessed for at least \$500 in the Commonwealth, with a charge of \$1; (3) the alien, at \$15; and (4) the resident, at \$1. The following table gives the income statistics for 1912, 1913 and 1914: —

YEAR.	Resident, \$1.	Non- resident, \$1.	Non- resident, \$10.	Alien, \$15.	Total.
1912,	\$47,886 40	\$84 80	\$1,018 45	\$1,507 65	\$50,497 30
1913,	51,963 45	125 65	1,532 00	1,820 70	55,441 80
1914,	61,192 25	137 20	1,264 70	2,372 70	64,966 85

Law relating to Non-sale of Game. — In October, 1912, Chief Clerk W. R. Collins and I visited New York to investigate the method used in that State for tagging imported game. The New York Conservation Commission courteously afforded every opportunity for study of their plan of work and furnished many helpful suggestions and much valuable information. The birds imported under chapter 567, Acts of 1912, which went into effect Jan. 1, 1913, were pheasants, black plover, grouse, red-legged partridge and certain other game. Considerable overtime work was entailed for the deputies near Boston, as large numbers of birds on hand at the various markets had to be tagged before they could legally be sold for food. Twenty-four thousand tags were placed on birds and animals, without hiring additional labor.

Migratory Birds. — Our department has been working in conjunction with the Federal authorities in enforcing the Federal migratory bird act. This law has already resulted in a remarkable increase in the number of game and other birds living in this State, and the bag on ducks and geese in 1914 certainly has been 50 per cent. larger than in 1913, while the number of game birds stopping here to nest is estimated to have increased about 500 per cent. Game can scarcely be said to be increasing as rapidly, but there is considerable redistribution. Birds are stopping to



feed and nest in places where they are given protection, especially on the large reservations along the paths of migration. Five of our deputies have been appointed Federal agents, thus having additional powers in the enforcement of the Federal law.

Forest Fires. — The deputies have rendered valuable assistance in discovering and extinguishing the forest fires. In 1913, 28 forest fires were reported by deputies. In 1914 the number reached 30. Many were found to be in charge of the proper authorities, others were reported to these officials, and in several instances small fires were extinguished by our deputies before any great damage had been done.

Respectfully submitted,

ORRIN C. BOURNE,
Chief Deputy.

MARINE FISHERIES.

The work on the marine fisheries, the most valuable of any State on the Atlantic coast, comprised a general oversight and enforcement of the laws, compilation of statistical records, scientific investigations, and suggestions, both official and informal, for the benefit of fishermen, dealers and consumers. Wonderful natural facilities by reason of geographical position have made Massachusetts a center for the sea fisheries; Boston furnishes a fresh fish market with unlimited opportunities, and Gloucester is pre-eminent in supplying salt fish and manufactured sea products. In order to maintain the commercial advantages and superiority of products which Massachusetts has held for years, the natural resources of the coastal waters must be developed to the utmost extent.

During the past ten years the activity manifested in all lines of business, industry and agriculture has shown itself in improved methods of fishing and in increased conveniences and safety for fishermen. Old methods of catching and handling fish have given place to more efficient means. The influence of the steam trawler, the motor boat, modern sanitary measures, cold storage and increased transportation facilities have all worked toward the improvement of the fishing industry, ultimately for the benefit of the consumer by extending the possibilities of furnishing food fish to wider territories. Our investigations upon the fisheries of Buzzards Bay have demonstrated the need of Federal oversight of trap fishing along the Atlantic coast. The migratory fish which annually resort to particular bays, estuaries and rivers for the purpose of spawning cannot

be regarded as the peculiar property of the States through whose waters they may chance to pass on the way to their breeding grounds, nor yet of the State in which they may breed. They are a national asset, useful as food for inland as well as seacoast communities, and should not be exposed to undue perils when approaching their spawning places. The relatively small size of the States in the Atlantic section results in much unwise though legal destruction of fish in one State when approaching the natural spawning grounds just over the line of the adjacent State, *e.g.*, Rhode Island and Massachusetts. Many flagrant abuses can be adjusted only by national control of migratory fish, with the establishment of suitable laws adapted for meeting special conditions existing in adjacent States. Every person interested in maintaining unimpaired our great national fisheries should actively support such a measure in Congress.

Deep Sea Fisheries.

The statistics and information here given were compiled by the Boston Fish Bureau, to whose excellent reports the reader is referred for greater detail regarding the marketing of fish for the years 1912, 1913 and 1914.

Salt Mackerel. — In 1912 the catch was mostly small fish, counting from 300 to 325 to a barrel. In the summer of 1913 a body of tinker mackerel extended along the shore, especially on the coast of Maine, where the catch was larger than in a number of years. The market conditions, however, did not encourage their sale. In 1914 the shore catch was mostly small fish, running 300 to 400 per barrel.

Salt Codfish. — At the beginning of the year 1912 salt codfish prices ruled high, the bank boats returning with light catches. Owing to the good prices fish came from the Pacific coast. During 1913 light catches and high prices prevailed, and again this condition resulted in the obtaining of more fish from other places, *viz.*, Canada, Newfoundland, Iceland and the Pacific coast. In the year 1914, owing to low prices for fresh fish, considerable quantities, especially of small fish, were cured. At Gloucester a cargo of 1,500,000 pounds of codfish was received from Iceland, which, in addition to being the first direct ship-

ment from that country, comprised the largest cargo of codfish ever landed in America. Although the catch on the Pacific coast was large, little was sent because the western dealers were unable to compete with Canadian and foreign shippers.

Fresh Fish. — In the year 1912, 3 steam trawlers were added to the fleet, and the whole fleet numbered 443, of which 264 were sailing vessels, 22 steamers, 7 steam otter trawlers and 150 boats of various kinds. The gill-netting fleet increased to 38, as compared with 17 of the previous year. In 1913 the whole fleet numbered 373, of which 196 were sailing vessels, 17 steamers, 10 otter trawlers and 150 boats of various kinds. The fleet of gill netters fishing off Gloucester was about the same size as in the previous year, and landed about 12,000,000 pounds, as compared with 10,000,000 for the previous year. In 1914 the gill netters landed only 8,500,000 pounds. The 1914 fleet numbered 330, of which 168 were sailing vessels, 11 otter trawlers and 150 boats of various kinds.

Fresh Mackerel. — The receipts for 1912 were mostly small fish, which were in good demand. In 1913 the total catch was 48,126 barrels, as against 31,861 in 1912. The largest body of small mackerel seen for several years entered Ipswich Bay in the month of October, and the small vessels made good catches. A large body of fish between Montauk Point and Nantucket caused a considerable reduction in price. The total catch of fresh mackerel amounted to 67,553 barrels in 1914.

Swordfish. — The season of 1913 proved most successful, the first fish being received June 4. Large quantities were taken on Georges banks during this year, but in 1914 they were not as plentiful as in the previous season.

Halibut. — The receipts at Boston and Gloucester from the fishing fleet in 1912 aggregated 3,028,789 pounds, against 3,188,155 in 1911. The catch on the Pacific coast was less than the previous year, in spite of the increased demand in that section. In 1913 the catch was the best for a number of years, but in 1914 it was moderate, while there were good returns on the Pacific coast.

Shore Fisheries.

The returns of the shore net and pound fisheries are made annually, under section 119 of the Revised Laws. Upon application the commissioners provided fishermen with suitable blank forms for these reports. All information is held confidential, the only purpose of the act being the collection of correct data upon the shore fisheries. Unfortunately, all Massachusetts fishermen have not seen fit to comply with the law by making applications for the blanks and submitting the proper returns. Nevertheless, in spite of their incompleteness, the statistics are valuable for a comparative study of the fisheries, as approximately the same number of men from the coast towns have made returns each year. The following table gives the relative abundance of the different species of fish and the statistics of the shore fisheries of Massachusetts for the past ten years: —

Statistical Returns of Shore Fishermen.

Fish.	1905.	1906.	1907.	1908.	1909.	1910.	1911.	1912.	1913.	1914.
Alewives, .	877,055	486,467	621,113	1,276,132	1,207,505	1,452,809	1,481,860	1,076,462	594,045	653,058
Bluefish, .	31,948	42,536	11,308	30,396	50,767	25,390	95,485	29,066	17,034	17,551
Flounders, .	1,124,196	812,398	922,534	667,928	1,181,240	1,294,868	1,265,901	1,375,749	181,996	1,027,205
Maackerel, .	560,450	1,219,021	816,915	302,109	593,263	320,066	738,558	1,064,806	727,468	1,295,320
Menhaden, .	152,080	19,425	3,525	300	18,340	277,087	334,216	294,740	5,301	133,403
Pollock, .	3,570,209	1,645,567	1,745,313	774,702	797,281	1,332,572	869,079	149,855	151,866	285,899
Salmon, .	1,240	144	15	23	—	—	9	9	—	—
Scup, .	710,595	257,353	420,043	314,188	99,290	215,816	121,380	156,633	166,170	111,069
Sea bass, .	8,950	20,095	14,725	12,827	81,751	5,557	20,286	56,530	253,864	11,197
Shad, .	1,951,201	3,075,820	2,167,683	2,619,451	2,944,755	1,394,289	3,367,020	1,887,272	1,579,021	1,775,877
Squeteague, .	115,771	50,686	97,410	49,594	25,350	95,707	60,772	185,321	7,006	8,118
Striped bass, .	3,574,635	2,027,361	2,121,112	394,904	240,058	184,355	151,603	73,236	23,588	7,128
Squid, .	3,497	4,005	41,422	42	1,788	184,304	177	455	822	50
Tautog, .	514,021	408,555	929,290	1,873,078	2,885,433	1,471,775	1,384,721	1,181,829	627,319	467,125
Other edible fish, .	2,857	12,564	33,600	12,298	12,786	24,368	17,376	16,396	20,109	31,893
Lobsters, .	3,661,301	4,770,399	3,622,704	3,999,400	3,053,198	3,065,086	4,170,323	2,207,033	1,985,991	3,703,524
	639,708	730,998	1,559,529	1,552,685	1,989,326	1,440,066	1,233,120	956,540	814,595	849,299
Total pounds, .	17,525,278	15,553,727	15,328,291	13,880,057	15,182,231	12,600,115	15,011,886	10,697,182	8,156,252	10,377,716
Total value, .	\$337,763 34	\$253,683 44	\$262,127 91	\$166,121 86	\$406,014 80	\$342,466 32	\$364,812 92	\$295,297 70	\$258,044 72	\$300,674 54
Number of returns, .	—	136	117	93	103	105	95	96	79	67
Number of men, .	774	430	363	309	269	333	319	296	279	256
Number of boats, .	725	372	325	280	319	289	277	275	240	227
Value of boats, .	\$115,274 00	\$69,400 50	\$65,587 00	\$53,328 00	\$68,131 00	\$64,544 00	\$62,230 00	\$67,773 00	\$45,709 00	\$49,904 00
Number of traps, .	148	115	126	116	119	100	96	135	84	61
Value of traps, .	\$116,425 00	\$110,680 00	\$96,335 00	\$83,200 00	\$80,750 00	\$69,600 00	\$64,375 00	\$65,612 00	\$58,900 00	\$57,500 00
Number of nets, .	1,606	1,641	1,212	975	1,306	1,253	1,184	1,065	816	837
Value of nets, .	\$19,304 00	\$19,591 50	\$17,209 00	\$16,162 00	\$18,591 00	\$20,794 50	\$16,120 00	\$17,725 00	\$14,567 00	\$14,329 00

Mollusk Fisheries.

A report upon practical clam culture after several years' work is now completed and ready for publication. Further investigations have been carried on in regard to food of the marine mollusca, and the various improvements in the shellfish industries have been followed during the past three years.

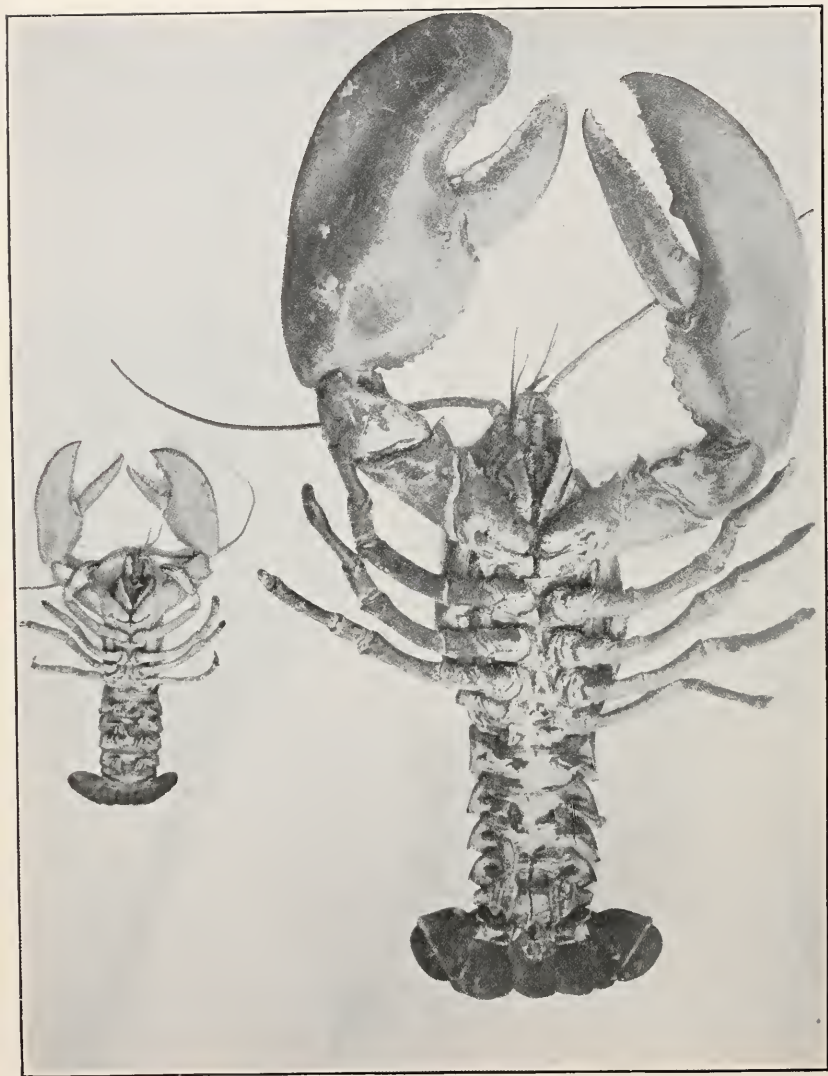
Quahaug. — The most important recent development in the shell fisheries of Massachusetts has been the exploitation of a large quahaug bed in Nantucket Sound. This productive area was discovered by the fishermen, who noticed quahaugs in their otter trawls. A small portion of the bed lies within the three-mile radius of Nantucket, but the greater part, covering many square miles, extends northerly and westerly. Its situation, practically outside of the three-mile limit, permits boats from other States to engage in the fishery, much to the detriment of local interests, as large dredgers from Rhode Island and Connecticut carry away many thousand bushels. Excellent catches, mostly medium and large quahaugs, are taken with dredges similar to the type used in the sea clam fishery. The boats for the most part are operated by gasoline power, which is also employed in hauling the dredges. From Nantucket and Edgartown the quahaugs are shipped to the Boston and New York markets, where the direct result of a greatly increased supply has caused a considerable reduction in price. Nevertheless, this veritable bonanza has yielded great profits to the quahaug fishermen.

Although apparently inexhaustible, within a few years this extensive bed will be depleted, owing to the destructiveness of the present style of fishing. The results are forgotten in the entirely probable expectation of finding other beds of similar nature, and such areas, when opened for fishing, should form important acquisitions to our shellfisheries. It is sincerely to be regretted that adequate methods of distribution have not been developed, or, in the absence of such, that there should be no definite method of regulating fishing in these waters, since the territory is situated without the three-mile limit, and therefore does not come under the jurisdiction of the State. If regulation were possible, in view of the overstocked market it might be advisable to put a limit on the daily catch, in order

that the fishermen might be given extra years of fishing in this locality. Only through private control, and the development of the quahaug farm with adequate facilities for worldwide distribution of the product, can the real interests of the fishermen and consumers be permanently advanced.

Oyster. — The oyster industry has to some extent increased on Cape Cod. In Buzzards Bay the dredging of the Cape Cod Canal caused considerable damage to the oyster industry, and, as required by chapter 448, Acts of 1899, the Commissioners on Fisheries and Game assessed the amount of damage to the various oyster grants near the entrance of the Cape Cod Canal in the towns of Bourne and Wareham. Twenty-six civil suits, aggregating \$106,000, with twenty-four claimants, were entered against the Boston and Cape Cod Canal Company. Hearings before the commissioners were held at Buzzards Bay, Hyannis and Boston. Their decisions covered two main propositions: (1) the utter destruction of the oyster beds by the channel of the canal; (2) the damage to the near-by grants during the dredging by suspended silt and other material in the water, which destroyed or rendered unmarketable the oysters on these grants. The canal company appealed from the decision of the commissioners, and the matter is still under litigation between the canal company and the claimants.

Clam. — Notable progress has been made in clam culture, especially in Plymouth and Barnstable harbors. At Plymouth the Andrew J. Kerr Company has leased 260 acres of flats from the town authorities, and has made a successful undertaking of raising clams on a large scale on practically barren flats, which were planted with seed clams from other localities. The establishment of this industry is a distinct benefit to the town of Plymouth, furnishing additional taxes and at the same time establishing a spawning center for seeding the public flats in the harbor. On the other hand, neither the State nor the town of Plymouth receives a direct revenue from the leasing of such a valuable privilege. We are of the opinion that since the right of fishing is a public one such valuable privileges should yield a revenue to the State, and that a return, based on a fixed price per acre, should be paid into the State treasury, while the town would benefit from the increase of taxable property.



The smaller lobster weighed $1\frac{1}{2}$ pounds; the larger, 23 pounds; showing relative size.
(After Herrick.)

The Lobster Fishery.

Decline. — Special attention is called to the deplorable condition which now exists in the lobster fisheries, not alone in this State but in all States along the Atlantic coast. Commercialism has dominated the lobster fishery of the past twenty-five years, and the public has been blindly led to believe that the supply of lobsters could not be seriously depleted. On account of the trade in live lobsters from Nova Scotia and Maine, the actual conditions have been efficiently masked, but an extremely small per cent. of the lobsters consumed in Massachusetts now come from Massachusetts waters, and the actual situation is especially evident to those who attempt to seek lobsters in places where they were formerly abundant. Nevertheless, these localities, except where pollution is obvious, are as well suited for producing lobsters as formerly. The actual catch, however, has been seriously reduced, as a result of unwise legislation, whereby the reproduction of the lobster race has been greatly impaired by killing the best breeders. Previous reports have demonstrated the extent of this decline, and have shown how the State has permitted this profitable industry to diminish to its present status, so that any lengthy discussion of this self-evident condition is needless.

In spite of the fact that absolutely complete returns of all Massachusetts lobster fisheries have never been obtained, the validity of the figures in the table below is in no way impaired, owing to the fact that the points which this table strikingly brings out are based entirely upon ratios, viz., the average catch per pot and the number of egg-bearing lobsters to the total reported catch. In 1907 the catch reported in marketable lobsters suddenly increased because the law allowed the taking of lobsters 9 inches in length instead of $10\frac{1}{2}$, the previous size limit. The largest catch is found in 1888, when 1,740,850 lobsters over $10\frac{1}{2}$ inches were taken. The lowest catch of $10\frac{1}{2}$ -inch lobsters was recorded in 1905 when 426,471 were taken. Under the new law in 1909 the high-water mark was reached, when 1,326,219 lobsters over 9 inches were taken. But the supply of these lobsters has gradually fallen in the same way, until in 1913 only 543,129 were taken. At the same time the number

of traps has varied between 13,877 and 29,996. The following statistics on the lobster fishery present a concise statement of the actual situation in Massachusetts, and are worthy of a careful perusal by the intelligent reader:—

DATE.	Fisher- men.	Traps.	Number of Lobsters above 10½ Inches.	Egg- bearing Lob- sters.	Average Catch per Pot.	Ratio of Egg Lobsters to Total Catch.	Average Ratio of Egg Lobsters, Five-year Periods.	Average Catch per Trap, Five-year Periods.
1888,	367	21,418	1,740,850	—	81	—	1: 27.06	76.0
1889,	344	20,016	1,359,645	61,832	68	1: 21.90		
1890,	379	19,554	1,612,129	70,909	82	1: 22.70		
1891,	327	15,448	1,292,791	49,973	84	1: 25.80		
1892,	312	14,064	1,107,764	37,230	79	1: 29.75		
1893,	371	17,012	1,149,332	32,741	62	1: 35.10	1: 33.08	49.4
1894,	425	20,303	1,096,834	34,897	54	1: 31.14		
1895,	377	17,205	956,365	34,343	56	1: 27.80		
1896,	453	22,041	995,396	30,470	45	1: 32.60		
1897,	388	18,829	896,273	23,719	48	1: 37.70		
1898,	340	16,195	720,413	19,931	44	1: 36.10	1: 38.82	36.3
1899,	327	15,350	644,633	16,470	42	1: 39.10		
1900,	309	14,086	646,499	15,638	46	1: 41.30		
1901,	331	16,286	578,383	16,353	35	1: 35.30		
1902,	410	20,058	670,245	—	34	—		
1903,	300	20,121	665,466	—	33	—	1: 84.68	40.2
1904,	326	19,539	552,290	13,950	28	1: 39.60		
1905,	287	13,829	426,471	9,865	31	1: 43.20		
1906,	335	21,918	487,332	9,373	22	1: 52.00		
1907,	379	21,342	1,039,886	10,348	49	1: 100.40		
1908,	349	19,294	1,035,123	9,081	54	1: 114.00	1: 121.14	30.8
1909,	522	29,996	1,326,219	11,656	45	1: 113.80		
1910,	390	26,760	935,356	7,857	35	1: 68.10		
1911,	341	19,773	822,107	5,488	42	1: 149.80		
1912,	291	16,665	631,595	4,744	38	1: 133.10		
1913,	254	13,877	543,129	3,408	39	1: 159.40	1: 95.40	
1914,	310	16,128	566,191	5,932	35	1: 95.40		

¹ Number of lobsters above 9 inches.

The most accurate way to consider the question of the decline of the Massachusetts lobster fishery is to take the average number of lobsters caught per pot between 1888 and 1914 at five-year intervals. In spite of the increase with the change in the size limit, there has been a steady decline from a maximum of 81 per pot in 1888 to a minimum of 28 per pot in 1904 and 35 per pot in 1914. The average for the five years between 1888 and 1894 was 76 per pot; between 1894 and 1899, 49.4; between 1899 and 1905, 36.3; between 1905 and 1910, 40.2; and between 1910 and 1915, 30.8. From a comparison of the number of men and pots, it is evident an increased number of men and pots fishing over a wider territory have not been able to increase the catch, owing to the fact that the number of lobsters has diminished. Another factor which points to the

decline in the supply of the lobsters is the ratio of egg-bearing lobsters to the total catch. In 1889 the ratio was 1:22, and in 1913 it was 1:159. The average ratio from 1889 to 1894 was 1:27; from 1894 to 1899, 1:33; from 1899 to 1905, 1:39; from 1905 to 1910, 1:85; and from 1910 to 1915, 1:121. These figures give the decrease in egg lobsters, and show that the reproductive capacity of lobsters has even more seriously decreased than is indicated by the diminution in the actual supply. In spite of all statements as to the relative increase in abundance in various localities, no other conclusion is tenable except that the Massachusetts lobster industry is steadily declining. Unless a radical change in policy is made for the protection of the lobster, the future of this fishery in Massachusetts is seriously threatened.

The causes of this alarming decline in the lobster supply is due to three factors:—

(1) Overfishing, whereby such inroads are made in the natural supply that the normal productivity of the animals cannot be maintained. The system is defective in that it puts a premium upon the destruction of adults as soon as, after having escaped the natural hazards of their developmental life, they approach the breeding age; in other words, "we are catching the *wrong* lobsters."

(2) The capture of small, immature lobsters has done much to decrease the natural supply, while the fishermen has benefited but little from this illegal practice, as he has been forced to sell his "shorts" at a figure considerably lower than the market price.

(3) The illegal destruction of egg lobsters has been the most striking cause of the decline of the lobster fishery, in spite of the fact that attempts have been made to purchase the egg lobsters. It was the former custom of the fishermen to carefully remove the eggs from the female lobster with a brush or a mitten, in order to make the lobster marketable.

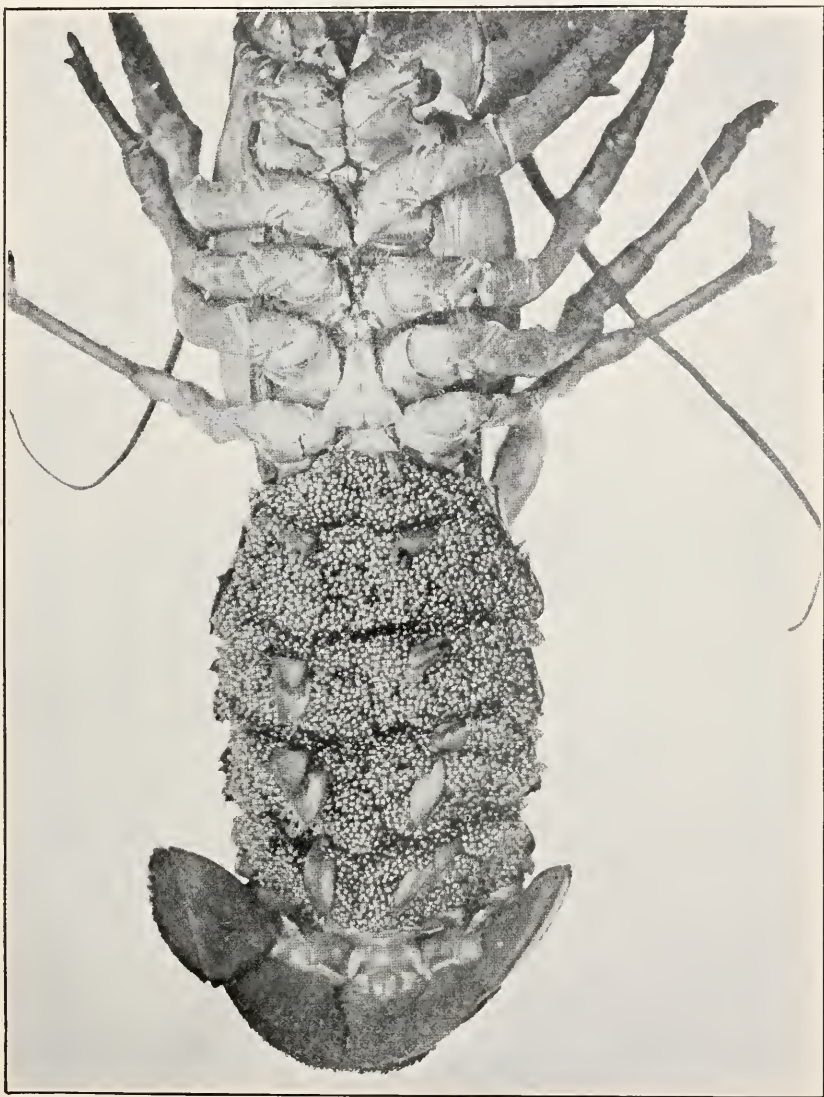
The fundamental condition underlying these causes is unwise legislation. Our attitude toward the lobster has been entirely wrong. Our laws have aimed to restrict the catch by protecting the small, immature lobsters, and have not considered the more vitally important protection of the old lobsters, male and female, of breeding age. In previous reports attention has

been called repeatedly to this economic fallacy, and a practical means has been presented whereby the lobster fishery in Massachusetts could be saved through protecting the large, spawning lobsters. In brief, our solution would prevent the destruction of the lobsters below the size suitable for market, *i.e.*, below 9 inches, and protect by a closed season during the entire year those lobsters of value to the species as breeders, above 12 inches in body length. These conditions can be made by requiring that lobsters be taken only with a trap having an entrance ring the inside diameter of which does not exceed $3\frac{1}{2}$ inches. In this way an automatic closed season for the best breeding stock is established, in addition to protecting the smaller lobsters, while at the same time lobsters of economic size, between 9 and 12 inches, may be taken for market.

Egg Lobsters. — For a number of years the Commonwealth has expended considerable money in attempting to preserve the lobster industry by purchasing egg-bearing lobsters, with the assumption that the greater proportion of the eggs would be destroyed by "stripping" if they were not purchased at the market price. Since the law forbidding the capture of egg lobsters could not be enforced unless a deputy accompanied every lobster fisherman in his boat, the more simple means of reimbursing the fishermen was taken. The "brown egggers" were shipped to the United States Bureau of Fisheries hatcheries at Woods Hole and Gloucester, which returned a due portion of lobster fry, and the "green egggers" were liberated when purchased. The collection and distribution of egg lobsters for the years 1912, 1913 and 1914 are tabulated as follows: —

Egg Lobster Collection and Distribution.

	1912.	1913.	1914.
<i>Collection.</i>			
North of Cape Cod,	2,033	1,466	1,507
Monomoy Point, Cape Cod,	2,037	987	2,113
Buzzards Bay,	163	42	13
Total,	4,233	2,495	3,633
<i>Distribution.</i>			
Woods Hole, United States Bureau of Fisheries hatchery,	221	35	—
Gloucester, United States Bureau of Fisheries hatchery,	43	—	—
North of Cape Cod (liberated),	1,932	1,466	1,507
Monomoy Point, Cape Cod (liberated),	2,037	987	2,113
Buzzards Bay,	—	7	13
Total,	4,233	2,495	3,633

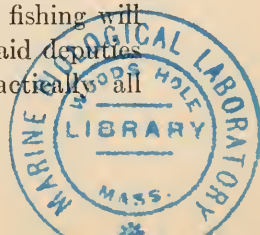


Female lobster, showing method of carrying eggs externally for ten or eleven months, until hatched. (Reproduced by courtesy of Rhode Island Commission of Inland Fisheries.)



Lobster Meat. — Section 5 of Chapter 643, Acts of 1913, authorized the Commissioners on Fisheries and Game to make suitable rules and regulations relative to the sale of lobster meat. After a public hearing on Feb. 4, 1914, at which opportunity was given to dealers and others to present testimony upon the question of granting permits, it was finally decided, after due consideration, that it would be manifestly unfair to the business interests if the dealers, especially in Boston, were not given the privilege of removing lobster meat from the shell for sale at their regular places of business. These same conditions did not apply equally to localities outside of Boston, where lobster shipments from outside of the State were not handled. The regulation of these permits was extremely important, since it afforded excellent opportunities for the illegal evasion of the short-lobster law. The policy of the department has been to issue as few permits as possible, and only to those dealers having law-abiding records. In 1913, 53 permits were issued; in 1914, 38. Each applicant was required to submit, on a regulation blank form, information regarding the localities from which he received lobsters, the approximate amount obtained from each place and the exact location where the meat was to be taken from the shell.

Lobstermen's Associations. — Most noteworthy and far-reaching steps in the preservation of the lobster fishery have been made by Massachusetts fishermen upon their own initiative. These men realize that their business is seriously threatened, and stand ready to do all in their power to preserve a fishery which for many years has been their main source of livelihood. Within the past year a series of associations, starting with the Cape Ann Lobstermen's Association, has been formed along the coast from Rockport to Plymouth. These associations have regular meetings, and the entire federation meets annually to suggest and draft proposed legislative measures for the benefit of the lobster industry. The purpose of these associations is to protect the lobstermen who desire to obtain an honest living, and to improve the condition of the fishery by the protection of the "short" and "egg" lobsters. It is also desirable that certain areas be set apart as reservations, where no fishing will be allowed. Each association has a number of unpaid deputies who see that the laws are rigidly enforced. Practically all



associations liberate their "seed" lobsters without remuneration from the State, believing that it is for their own benefit to return lobsters to the same waters from which they came. The Boston Harbor Lobstermen's Association in 1914 liberated 1,224 egg lobsters. Such good work, particularly with regard to the immediate returning of the egg lobsters to the water, is worthy of encouragement.

NAME.	Towns.	Number of Members.	Date of Organization.
Cape Ann Association, .	Rockport and Gloucester, . .	85	Sept. 19, 1913
Boston Harbor Association, .	Boston, Quincy and Weymouth, .	23	June 27, 1914
Winthrop Association, . .	Winthrop,	9	Aug. 17, 1914
Marblehead Association, .	Marblehead, Salem, Beverly and Manchester.	60	Sept. 20, 1914
Nahant Association, . .	Nahant, Swampscott, Lynn and Beachmont.	25	Sept. 30, 1914
Cohasset Association, . .	Cohasset and Nantucket, . .	40	Oct. 1, 1914
Scituate Association, . .	Scituate,	35	Jan. 6, 1915

Legislation. — The following suggestions should be thoroughly discussed in view of future legislation: —

1. *Uniform Size.* — It is to be regretted that there is not more uniformity between the legal size limits for lobsters in the New England States; for instance, Maine has a limit of $4\frac{3}{4}$ inches measured on the back or carapace of the lobster, whereas Massachusetts has a 9-inch size limit for the entire length. It is eminently desirable that the New England States adopt some uniform law, but unfortunately, owing to political complications, it is difficult to agree upon a standard. Your commissioners recommend that the Maine method of measurement, upon the body shell or carapace, be used instead of upon the whole length of the lobster.

2. *Protection of Adults.* — At the present time the only practical method for retaining the supply is the exceedingly small measure of protection afforded by the prohibition of taking egg-bearing females, the hatching of eggs by the United States Bureau of Fisheries and the liberation of specimens under the legal size. Our lobster laws at the present time are so capable of facile evasion that their enforcement is obviously

impracticable. By the adoption of a standard trap with entrance rings of definite diameter, which would effectively exclude all lobsters above a certain size, *e.g.*, 12 inches, and the rigorous enforcement of the legal limit of 9 inches, the lobster fishermen would be permitted to catch marketable lobsters between 9 and 12 inches, and the large breeding lobsters above 12 inches in length would be automatically protected. This plan offers the only practical way by which the future supply of lobsters may be maintained, and at the same time permits the fishery to be carried on.

3. *Protection of Egg-bearing Lobsters.* — The present law protecting the egg-bearing lobster should be continued. Until the various lobstermen's associations assume complete charge of the liberation of these breeders, it is advisable to continue their purchase by the State, although their immediate return to the water by the fisherman is certainly a greater benefit to the fishery.

4. *Lobster License.* — The lobster associations believe that the granting of lobster licenses by the State would prove of great value in the protection of legitimate lobster fishing. Your commissioners likewise feel that such a law would be greatly in favor of the best interests of the lobster fishery. Licensing would make the enforcement of law more effective by providing that any person convicted of violations of the lobster laws should be refused a license for a year, thus eliminating pooling of interests and the pro rata assessment of fines among the members of any combination.

INLAND FISHERIES.

In addition to the salt-water fisheries, Massachusetts has extensive opportunities for the development of the inland fisheries the importance of which has not as yet been realized. There are 94,254 acres of ponds over 10 acres in area and no less than 4,000 miles of streams, although many are badly polluted by sewage and manufacturing waters, which offer exceptional opportunities for the cultivation of food and game fish. Each year this department continues to stock these waters more extensively with small fish. Approximately 600,000 fingerling and 2,000,000 brook trout fry have been distributed

in 1914 among the various streams of the State, while small-mouthed black bass, wall-eyed pike, yellow perch and white perch are being placed in the ponds and rivers. Likewise, certain large, deep lakes, which possess satisfactory natural conditions are being stocked with Chinook salmon. The four hatcheries which furnish the supply of fish for the different sections of the State are situated at Sandwich on Cape Cod, at Sutton near Worcester, at Adams in the Berkshires, and at Palmer.

The aim has been to acquire a thorough knowledge of the waters of the State, and for that reason a routine biological examination, as described in the report of the biologist, has been made of the ponds and streams within the borders of the Commonwealth. The purpose of this survey was to obtain a basis for a proper workable knowledge of the inland waters, in order that well-advised and systematic methods of stocking to obtain best results in fish distribution may be inaugurated. The ponds and streams have been classified according to their suitability for different species of fish, and the increasing output of the hatcheries can now be utilized in the most efficient manner. With such a system the best waters will be stocked, and each section of the State will receive its just allotment of fish. The present decline in our inland fisheries has resulted from a diminution of the flowage areas by the destruction of forests, from a restriction of the breeding places of fish, and from the inroads of pollution from city and manufacturing sources. To meet these changed conditions is a serious problem, particularly in the question of the pollution of our streams. Injury to fish life resulting from pollution is very widespread and notoriously conspicuous in Massachusetts, where there is an enormous waste of material which could more profitably be used for fertilizing our sandy farms. Much of this damage is entirely unnecessary, and can be remedied without imposing in any way a burden upon even the humblest manufacturing interests.

Fish.

Nine species of fish are now distributed among the inland waters of the Commonwealth. All except the white perch and bullhead are reared at the State hatcheries. A brief description of each species, largely taken from the "Fishes of New York," by Dr. Tarleton H. Bean, is given for the general information of the reader.

Brook Trout. — The speckled brook trout (*Salvelinus fontinalis*), or, more properly, "char," our most extensively propagated fish, is indigenous to the region east of the Allegheny Mountains and the Great Lake region, extending from North Carolina to Labrador. It has been artificially introduced in many of the western States and territories, and has even been sent to European countries. It ultimately reaches more than 7 or 8 inches in length, and in lakes large specimens, weighing 3 to 6 pounds, are sometimes found. The brook trout prefers a temperature of about 50 degrees F., and does not flourish in water over 68 degrees, choosing, therefore, as its habitat, cold, clear mountain streams free from pollution. Where the streams enter the salt water the fish has the habit of remaining in the ocean during the winter. These "salters" are highly esteemed by the fishermen for their beautiful color and excellent condition. In warm water the trout lies in deep pools, usually in the vicinity of cool springs. Spawning usually begins in October, and at the hatcheries eggs are taken chiefly during the months of November and December. The period of hatching depends on the temperature, ranging from one hundred and sixty-five days in water of 37 degrees to thirty-two days in water of 54 degrees. After the absorption of the yelk sac in from thirty to sixty days, the young fish begin to feed, the rate of growth depending upon the amount of food.

Brown Trout. — The brown trout (*Salmo fario*) of Europe was introduced in 1863, and has now become acclimated in many States, especially in the region east of the Rocky Mountains. It is apparently suited to larger streams and can exist under more adverse conditions than the brook trout, but prefers cool, clear mountain streams. Although more hardy

in captivity, it has been raised to a less extent than the brook trout at our State hatcheries. An interesting hybrid with beautiful markings was produced by crossing brown and brook trout at the Sutton hatchery.

Rainbow Trout. — The rainbow trout (*Salmo irideus*), which is a native of the mountain streams of the Pacific coast, has been introduced with some slight success in Massachusetts. This fish usually spawns in January, February or March, with an average yield of about 900 eggs. It will live in water of a higher temperature, and thrives in tidal streams.

Chinook Salmon. — The Chinook salmon (*Oncorhynchus tshawytscha*) of the Pacific coast is the largest and finest of the Pacific salmon. It has recently been introduced into Massachusetts with the hope that this valuable fish may become landlocked in our lakes. The practicability of rearing this fish in a landlocked condition has already been fully demonstrated in France. So far the most extensive stocking has been done in Lake Quinsigamond at Worcester, where excellent results have been obtained.

White Perch. — The white perch (*Morone americana*) is found in both salt and fresh water, and is frequently taken in large numbers in tidal creeks. Spawning takes place in May and June. The eggs are very adhesive, and on this account artificial hatching is difficult. In captivity it is very susceptible to attacks of fungus. No attempts have been made to rear the young fish, but large quantities of small adults, seined in the brackish water ponds, are annually shipped to the inland ponds, where the species become landlocked. White perch is both a gamey and an excellent pan fish, and for all classes of fishermen is perhaps the most satisfactory pond fish.

Yellow Perch. — The yellow perch (*Perca flavescens*), a native of Massachusetts, is abundant in the southeastern part of the State. It is found throughout the Great Lake region in the United States, and east of the Alleghenies as far south as Georgia. Spawning extends from December to April, and large quantities of eggs furnished by the United States Bureau of Fisheries are hatched each year at the Palmer hatchery for distribution.

Pike Perch. — The pike perch (*Stizostedion vitreum*), fre-



Unpacking Chinook salmon eggs, Palmer fish hatchery.



quently known as the wall-eyed pike, inhabits the Great Lake region, and has been introduced into Massachusetts by means of eggs and fry furnished by the United States Bureau of Fisheries. Spawning occurs in April and May, and the period of hatching consumes from fourteen to thirty days, depending on the temperature of the water. Although under natural conditions only a small percentage of the two to three hundred thousand eggs laid by a single female successfully hatch, under artificial conditions the number hatched in the MacDonald hatching jars is enormously increased. The fish is one of the finest game and food fishes in the United States. It has been successfully placed in the Connecticut and Merrimac rivers, and at the present time large quantities of fry are being annually hatched at the Palmer hatchery from eggs received from the United States hatchery at Swanton, Vt.

Bullhead. — The bullhead or horned pout (*Ameiurus nebulosus*) has a wide distribution, and is found in nearly all Massachusetts ponds where the conditions are satisfactory for its existence. It is usually to be found near the bottom, in muddy, weedy ponds, where it will take practically any kind of bait. The old fish accompanies the young for some time after they are hatched in order to protect them. At the end of the third year the fish is fully matured. This species has been placed in many ponds, particularly in the north central part of the State, where it is popular among the anglers for its excellent flesh, although no extensive propagation has as yet been tried. It is a hardy fish, and readily yields itself to pond propagation.

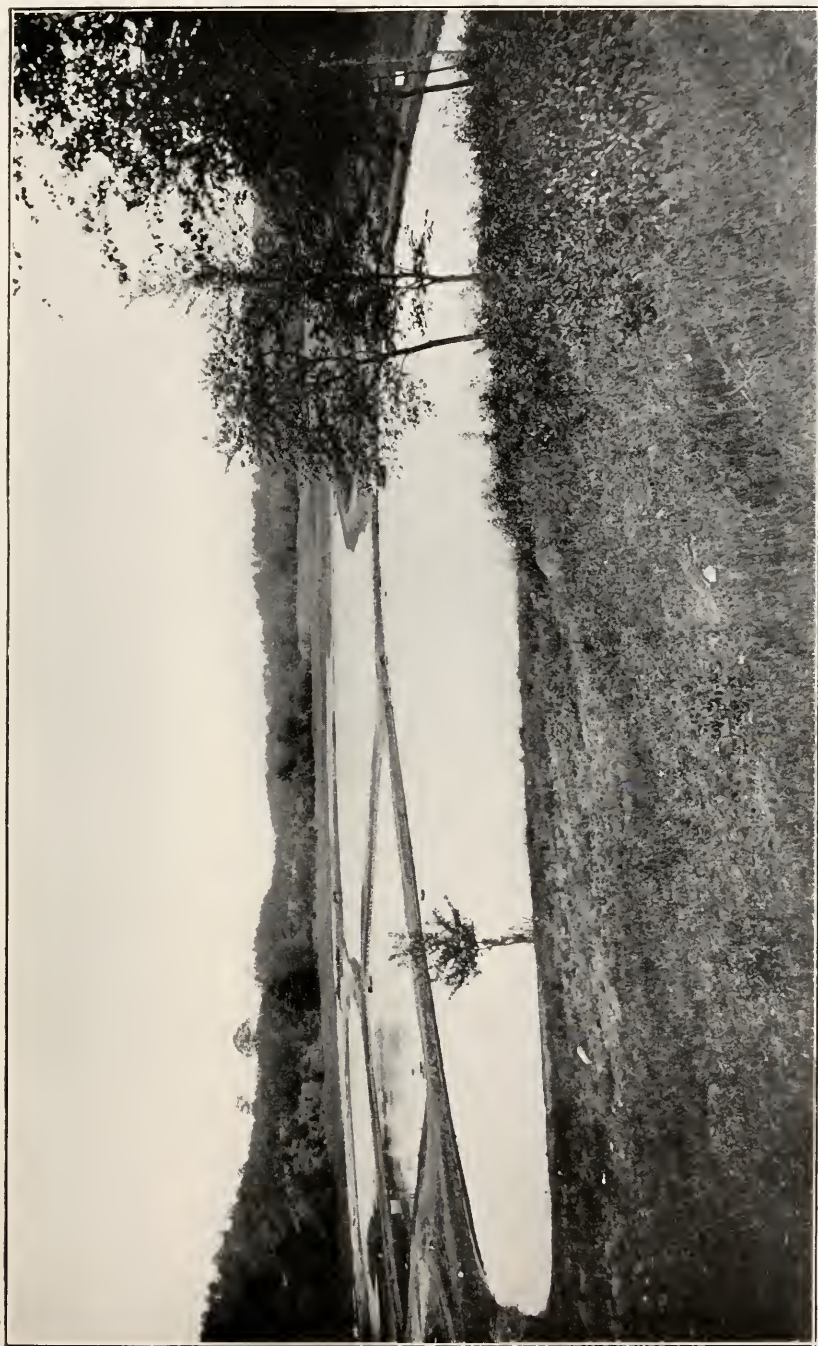
Black Bass. — Two species of black bass, the small and the large mouth varieties (*Micropterus dolomieu* and *M. salmoides*), were introduced and are now commonly found in Massachusetts. The small-mouth black bass, which is reared at the Palmer hatchery, is the more important and is more satisfactory, except for muddy ponds. This species is indigenous to the upper St. Lawrence, the Great Lakes and the basin of the Mississippi. It does not grow as large as the large-mouth, and frequents swiftly moving streams and clear lakes. It spawns on shallow, gravelly bottoms, the eggs incubating in from seven to fourteen days. At the hatchery the bass are kept in ponds, where suitable facilities are offered for the fish to nest.

The fish is a most excellent game fish, and furnishes great sport to all lovers of angling. In 1912 a bass hatchery was constructed in the town of Palmer, and in 1914 the propagation of this excellent game fish was begun in earnest. At the present time there are brood fish in the ponds, and a large number of small bass should be shipped from this station during 1915 for distribution in suitable waters which already contain bass.

It is the aim of this department to give all sections of the State as many kinds of fish as is consistently possible. Cape Cod, for instance, should have good salmon and trout fishing as well as white perch, and Berkshire should have white perch as well as trout and pickerel. Waters suitable for salmon will be stocked with salmon, for trout with trout, and so on for white perch, yellow perch, black bass and bullheads. A large number of lakes, shallow but well supplied with good, clear water, rocky bottom and sandy or gravelly shores, are perfectly suited for small-mouthed black bass, and other shallow lakes, with warmer water and muddy bottom, are ideal for large-mouthed bass. Both species are splendid game fish, and when taken in the same lake afford about the same amount of sport and have similar edible qualities. Large-mouthed bass are mostly taken in muddy, weedy ponds, and when cooked have a flat, muddy flavor. The same fish, if transferred to a cold, clear lake, free from mud, will taste entirely different, and prove a hard, sweet table fish.

Your commissioners are satisfied that by propagating and planting black bass they will satisfy a large number of anglers. Naturally it will not be policy for the State to supply bass for all lakes and ponds, and it must be left to the discretion of the commissioners to decide as to what waters shall be stocked for the benefit of the bass fishermen.

The first introduction of black bass into Massachusetts occurred in 1850, when 27 specimens from Saratoga, N. Y., were placed in Flax Pond, Wareham, by Samuel Tisdale. Later in the same year 100 others were distributed in White Island Pond, Pickerel Pond, Agawam Mill Pond and Sturtevant's Pond, in Wareham, Plymouth and Bourne. This was repeated



Rearing ponds for black bass, Palmer fish hatchery.





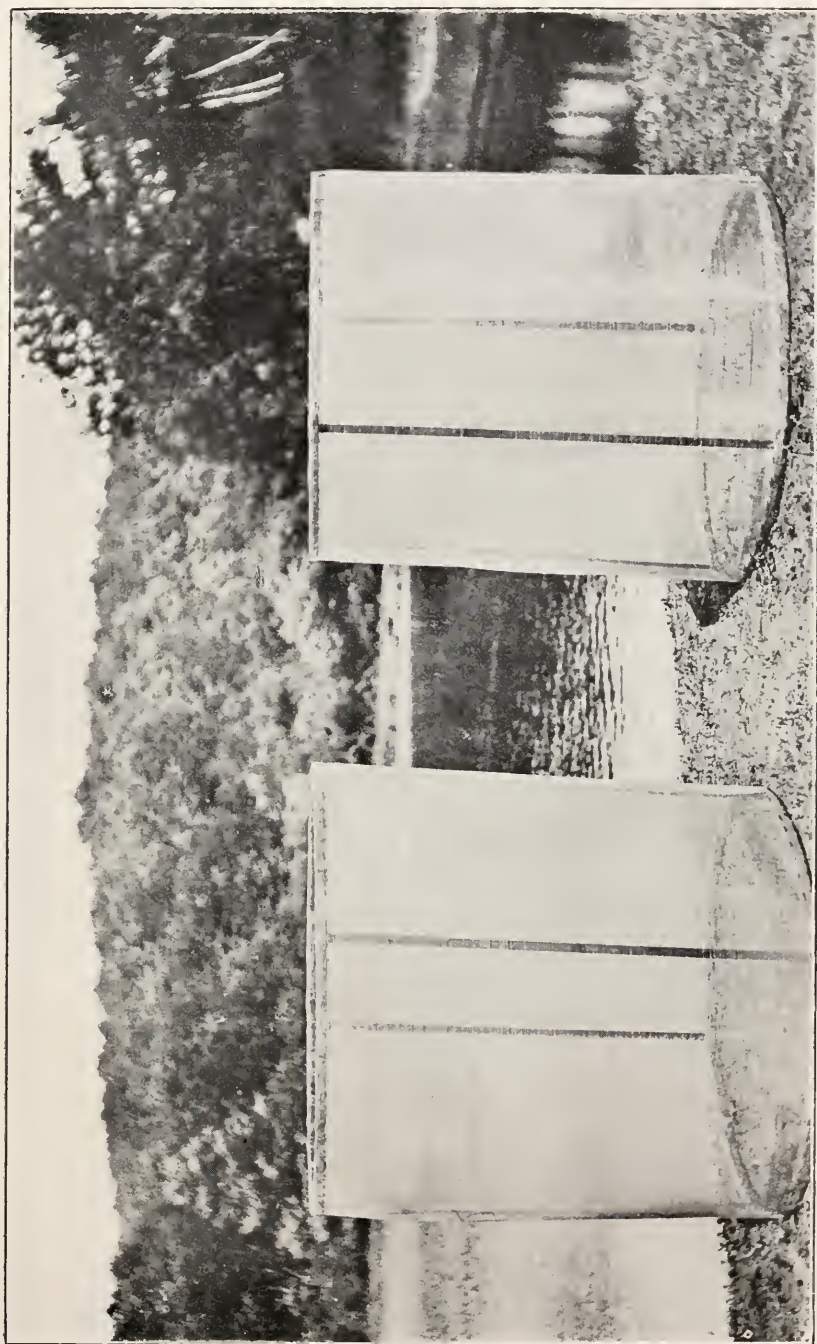
Rearing pond, showing artificial nests for small-mouthed black bass, Palmer fish hatchery.



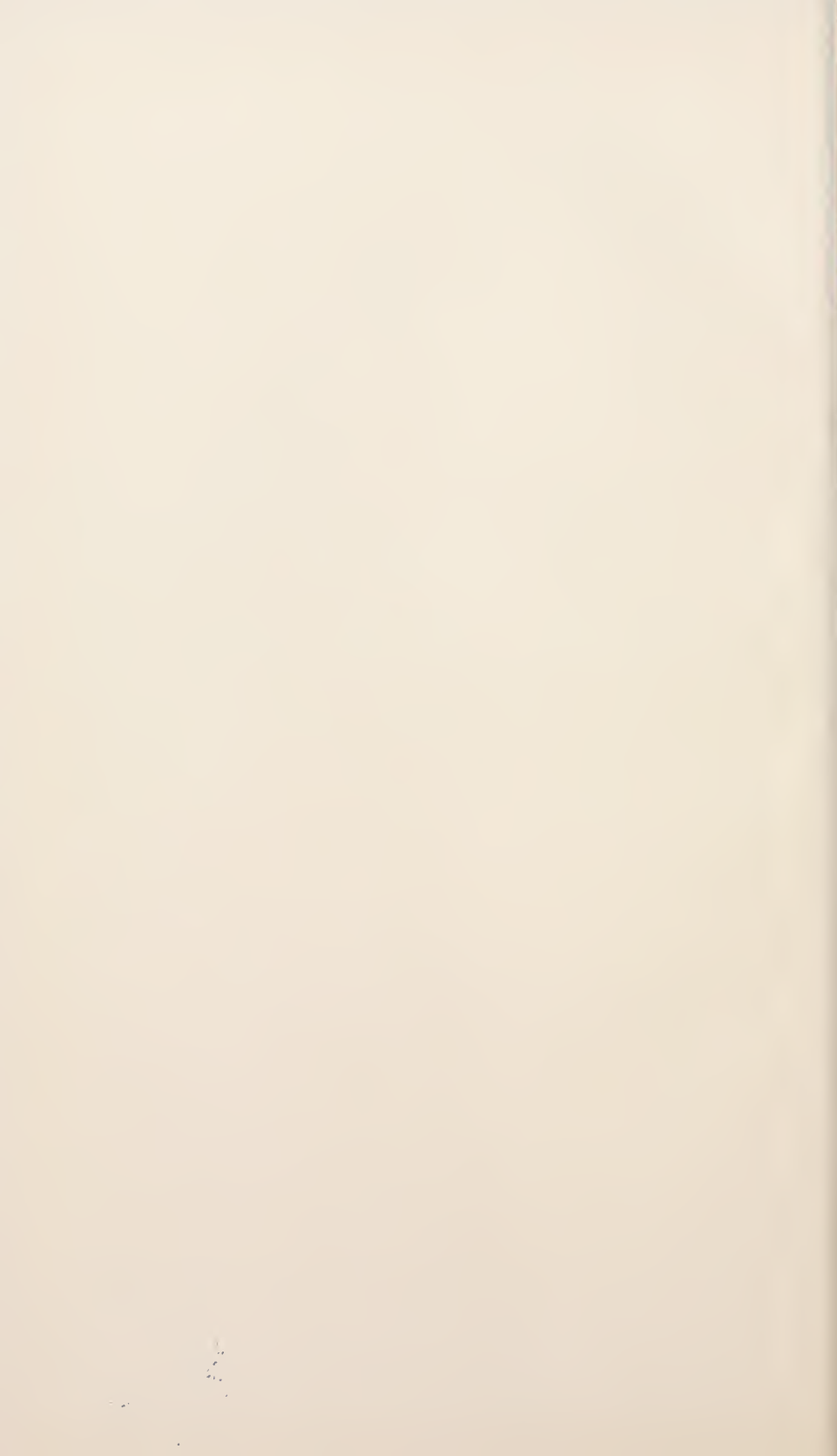


Artificial nest for small-mouthed black bass before the pond is filled with water, Palmer fish hatchery.





Wire screens placed over bass nests when the young are hatched, Palmer fish hatchery.

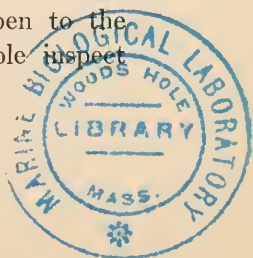


in 1851 and 1852, and from these and their progeny more than thirty ponds in that region were stocked.

Much has been learned by the fish culturist since 1850, and, largely through the work of Mr. Dwight Lydell of Michigan, the cultivation of bass has been brought to a high state of efficiency, and these fish can be raised in large numbers for stocking purposes. The bass hatchery at Palmer, which is the only bass hatchery that is operated by any New England State, has aroused much interest. Small-mouthed black bass are allowed to hatch under natural conditions, in specially prepared ponds in which spawning "nests" of gravel are placed. After the male fish has thoroughly cleansed the nest from all dirt he selects a female, which accompanies him to the nest and deposits her eggs. The male throws his milt over these eggs in order to fertilize them, then drives the female away and carefully guards the nest through the period of incubation.

Just before the eggs are ready to hatch the attendant places a wire screen over the nest, and as the young fish hatch they are confined within this screen, where they can be easily handled. Soon after the young hatch the old fish are taken out of the pond with a seine and the young bass left to care for themselves, since with few enemies they do not need the protection of the parent fish. Many of the young bass are sent out from the hatchery as fry a week or ten days after they rise up from the nest, for the reason that there is not pond room enough to hold the large numbers hatched, the pond being only capable of supplying food for a certain number. Young bass grow very rapidly in the ponds, necessitating a weekly reduction in numbers to get sufficient room for those remaining. The young fish are not fed artificially but subsist on the natural food in the ponds. About two weeks from the time the young fish are hatched they are perfectly formed bass. When fry are planted they must be placed along the shores in shallow water, among the weeds and grass, in order to afford sufficient protection from larger fish.

All of the hatcheries owned by the State are open to the public, and the commissioners desire to have people inspect



them. The superintendents at the different stations, whenever the work at hand will permit, are always willing to show visitors around and give them all needed information.

Fish Diseases. — Numerous cases of fish diseases have been brought to our attention during the past three years, and efforts have been made to determine their cause and to institute methods of prevention. Fish are subject to a number of parasitic diseases, especially at the hatcheries, where they are kept in closer confinement than in the natural state, necessitating constant supervision.

Fish Propagation.

Distribution. — A number of our native fish are not being propagated, but there are additional possibilities in the transplanting of valuable fish from waters where a species exists in quantities too great to permit proper development, as, white perch, horned pout, etc., and also in the introduction of species like the pike perch and black bass from other States into Massachusetts waters. Experiments should be made along these lines to see if many other valuable species are not capable of being reared in Massachusetts waters as successfully as our native fish.

The relative advantage of planting fry or fingerlings in our inland waters is a question upon which eminent fish culturists have radically disagreed, and forcible arguments have been presented by the advocates of both systems. Certain species, for example, pike perch, owing to their cannibalistic tendencies, can only be planted in the fry stage, while others, particularly the trout and salmon, can readily be reared to fingerlings. Your commissioners have found that from a practical standpoint both systems should be followed, as under the present circumstances it is most conducive to success to plant both fry and fingerlings. The fingerling method undoubtedly is more successful and certain, especially as applied to larger streams, but in addition fry should be used for smaller brooks and headwaters. At the present time our hatcheries are producing their full capacity of fingerlings, but a greater number of eggs can be hatched to the size of fry than can be raised to the fingerling size. Therefore

it is the policy of this department to use both systems of fish distribution to the utmost capacities of the hatcheries in an effort to suitably stock the inland waters. In fact, fry are an inexpensive by-product in the full utilization of the pools when fingerlings are reared, as distribution necessarily begins as soon as the fish, by reason of growth, begin to crowd.

The best results can probably be secured by planting both fry and fingerlings, but the increase of fish in the inland waters will depend more on the judgment and care observed in their distribution. This problem is in process of solution by an examination of all the ponds and fishing streams of the State, so that first-hand information as to the suitability of any body of water for stocking will be available.

Fish Distribution for the

1912.

COUNTIES.	Fry.	BROOK TROUT.			BROWN TROUT.			CHINOOK SALMON.	
		Finger-ling.	Year-ling.	Adult.	Fry.	Finger-ling.	Adult.	Finger-ling.	Adult.
Barnstable, . .	50,000	6,360	7,200	-	-	-	-	-	-
Berkshire, . .	480,000	83,500	400	-	-	-	-	-	-
Bristol, . . .	50,000	15,600	-	-	-	-	-	-	-
Dukes, . . .	-	-	-	-	-	-	-	-	-
Essex, . . .	20,000	3,500	-	-	-	-	-	-	-
Franklin, . .	83,000	19,500	200	-	-	-	-	-	-
Hampden, . .	328,000	22,500	2,900	-	-	-	-	-	-
Hampshire, . .	135,000	39,000	500	-	-	-	-	-	-
Middlesex, . .	120,000	28,300	-	-	25,000	1,000	150	-	-
Nantucket, . .	-	-	-	-	-	-	-	-	-
Norfolk, . .	60,000	10,500	300	-	25,000	-	-	-	-
Plymouth, . .	-	9,800	-	-	-	-	-	-	-
Suffolk, . . .	-	-	-	-	-	-	-	-	-
Worcester, . .	500,000	103,500	1,200	-	-	-	-	-	-
Total, . . .	1,826,000	342,000	12,700	-	50,000	1,000	150	-	-

1913.

Barnstable, . .	60,000	27,000	3,100	-	-	-	-	-	-
Berkshire, . .	563,000	34,500	-	-	-	-	-	-	-
Bristol, . . .	160,000	133,000	670	-	-	-	-	-	-
Dukes, . . .	-	10,000	-	-	-	-	-	-	-
Essex, . . .	170,000	77,500	-	-	-	-	-	-	-
Franklin, . .	80,000	25,500	-	-	-	-	-	-	-
Hampden, . .	213,200	49,000	-	150	-	-	-	-	-
Hampshire, . .	215,500	54,000	2,900	-	-	-	-	-	-
Middlesex, . .	410,000	140,000	-	-	45,000	-	-	-	-
Nantucket, . .	-	-	-	-	-	-	-	-	-
Norfolk, . .	100,000	24,000	90	-	135,000	-	-	-	-
Plymouth, . .	270,000	51,000	900	-	-	-	-	-	-
Suffolk, . . .	-	-	-	-	-	-	-	200	10
Worcester, . .	595,000	202,500	-	860	-	-	-	11,100	-
Total, . . .	2,836,700	828,000	6,760	1,010	180,000	-	-	11,300	10

Years 1912, 1913 and 1914.

1912.

SMALL-MOUTH BLACK BASS.			LARGE-MOUTH BLACK BASS.		WHITE PERCH.	LAND- LOCKED SMELT.	PIKE PERCH.	YELLOW PERCH.	HORNED POUTS.
Fry.	Finger- ling.	Adult.	Fry.	Finger- ling.	Small Adults.	Eggs.	Fry.	Fry.	Adults.
-	-	-	-	-	-	6,500,000	-	-	-
-	-	-	-	-	129	-	-	-	-
-	-	-	-	-	1,247	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	167	-	-	-	-
-	-	-	-	-	300	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	456	6,000,000	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	2,299	12,500,000	-	-	-

1913.

-	-	-	-	-	-	5,000,000	-	-	-
-	-	-	-	-	1,950	-	1,200,000	1,920,000	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	600	-	900,000	400,000	-
-	-	-	-	1,800	300	-	1,920,000	1,960,000	-
-	-	-	-	-	1,140	-	1,700,000	320,000	-
-	-	-	-	-	2,610	-	950,000	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	360	2,000,000	450,000	-	-
-	-	-	-	-	-	-	650,000	-	-
-	-	-	-	200	793	-	-	-	-
-	-	-	-	-	4,450	-	2,500,000	3,000,000	-
-	-	-	-	2,000	12,203	7,000,000	10,270,000	7,600,000	-

Fish Distribution for the Years

1914.

COUNTIES.	Fry.	BROOK TROUT.			BROWN TROUT.			CHINOOK SALMON.	
		Finger-ling.	Year-ling.	Adult.	Fry.	Finger-ling.	Adult.	Finger-ling.	Adult.
Barnstable, . . .	20,000	7,500	2,000	3,000	-	-	-	7,625	-
Berkshire, . . .	455,000	26,400	-	-	-	-	-	4,750	-
Bristol,	80,000	62,000	500	322	-	-	-	-	-
Essex,	120,000	95,800	250	-	-	-	-	-	-
Franklin,	180,000	29,700	-	-	-	-	-	-	-
Hampden,	320,000	33,100	1,450	200	-	-	-	-	-
Hampshire, . . .	240,000	59,950	250	3,000	-	-	-	-	-
Middlesex, . . .	240,000	50,500	500	-	-	-	-	-	-
Norfolk,	50,000	31,500	-	-	60,000	-	-	-	-
Plymouth,	150,000	37,500	-	-	-	-	-	-	-
Suffolk,	-	50	30	20	60,000	3,000	110	-	-
Worcester,	255,000	147,050	1,500	400	-	-	-	19,125	-
Total,	2,110,000	581,050	6,480	6,942	120,000	3,000	110	31,500	-

About 25,000 adult landlocked smelts

1912, 1913 and 1914 — Concluded.

1914.

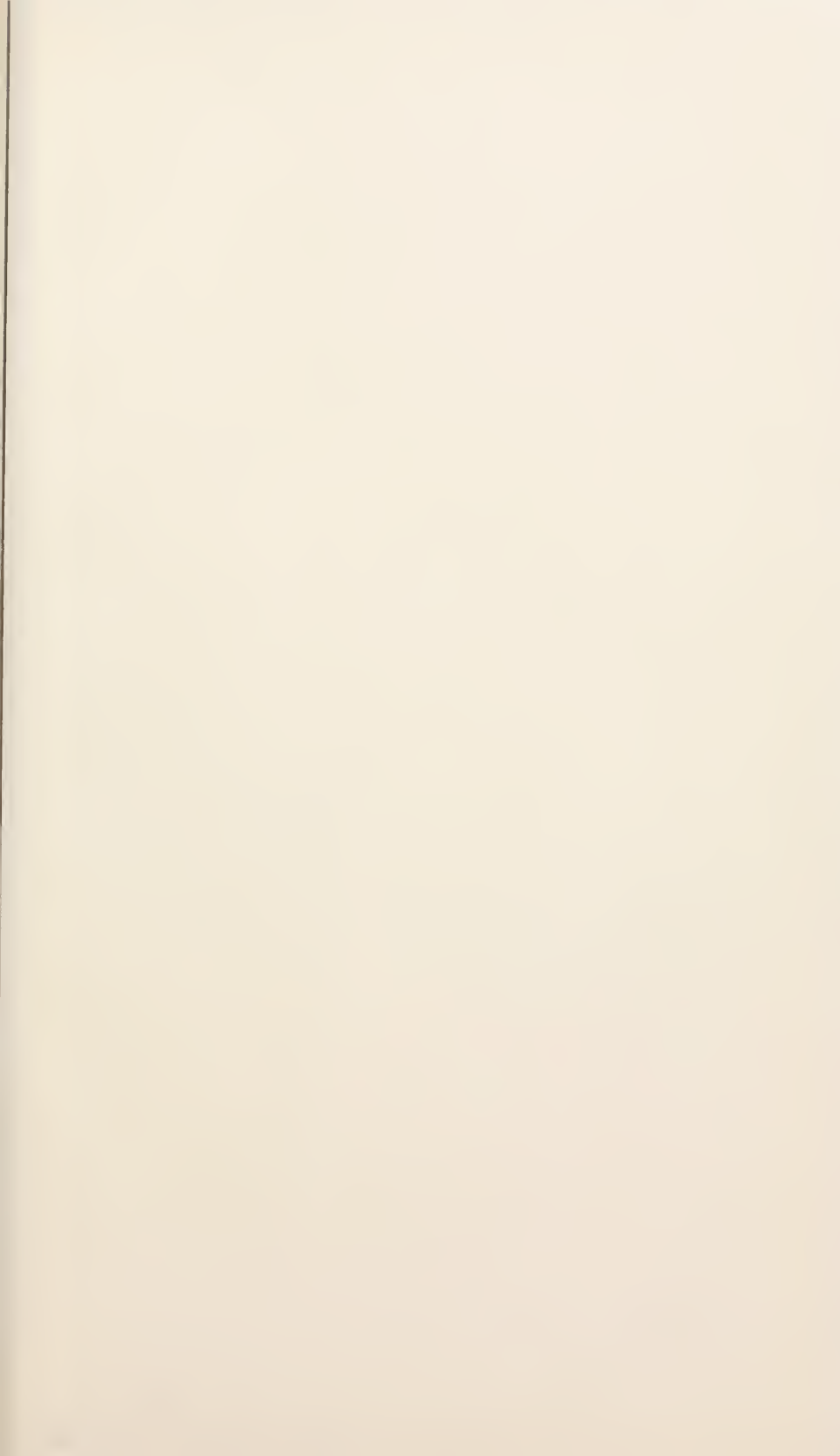
SMALL-MOUTH BLACK BASS.			LARGE-MOUTH BLACK BASS.		WHITE PERCH.	LAND- LOCKED SMELT.	PIKE PERCH.	YELLOW PERCH.	HORNED POUTS.
Fry.	Finger- ling.	Adult.	Fry.	Finger- ling.	Small Adults.	Eggs.	Fry.	Fry.	Adults.
-	2,000	-	-	-	-	-	1,500,000	-	-
20,000	26,700	-	8,000	-	-	-	4,950,000	2,600,000	1,200
-	5,400	-	-	-	3,150	-	500,000	-	-
-	3,000	-	-	-	1,440	-	200,000	-	-
-	750	-	-	-	-	-	1,450,000	-	-
-	1,100	-	-	-	-	-	3,400,000	-	1,000
-	5,250	-	-	-	-	-	800,000	-	1,000
-	1,500	-	-	-	2,200	-	900,000	-	1,400
-	2,700	-	-	-	-	-	500,000	-	-
-	1,800	-	-	-	-	-	500,000	-	-
-	-	3	10,000	300	-	-	-	-	-
-	2,400	-	-	-	13,520	-	2,050,000	-	7,000
20,000	52,600	3	18,000	300	20,310	-	16,750,000	2,600,000	11,600

were distributed in various lakes in 1914.

The increase in production has been due to the development of two new hatcheries at Sandwich and at Palmer, in addition to the extensions at the Sutton and Adams stations, all of which are now in operation. The Sandwich hatchery is potentially one of the finest trout hatcheries in the country, and at Palmer extensive ponds have been made for the propagation of small-mouthed black bass.

Adams Hatchery. — The Adams hatchery, in the Berkshires, was established under chapter 60, Resolves of 1898, at a cost of \$2,500. At the present time, during the spring and winter months this hatchery raises approximately 600,000 trout fry which are distributed to the western streams. The State property at the Adams hatchery consists of $2\frac{1}{2}$ acres of land and a brick hatching house, 35 by 40 feet. The superintendent, who receives \$240 per year, is the only paid employee, and the total cost of running the hatchery for the year 1914 was \$350.11. It is essential to have hatcheries of this type in different parts of the State to take care of the abundance of eggs which are now produced at the Sandwich hatchery, and to distribute the fry.

Palmer Hatchery. — A distributing center of sufficient size to comply with the increasing demand for fish propagation in the western part of the State was at length provided by the establishment of a well-equipped modern hatchery at Palmer, Hampden County, in 1911, under chapter 271 of the Acts of 1911. The choice of this location, and the general plan on which this station is being developed, was adopted only after careful study and upon the advice of the best experts in the United States. When complete this hatchery will be one of the largest and best in the country. The hatchery is ideally located on a stream which is a tributary to Forest Lake, about 1 mile beyond Palmer Center on the direct road to Ware. Its proximity to Palmer, an important railroad center 15 miles east of Springfield, affords excellent facilities for rapid and economical distribution of fry and fingerlings to all parts of central and western Massachusetts. The natural facilities as regards location, water supply and rearing ponds permit the hatching and rearing of many species of inland fish, a strikingly unique advantage, which should place Palmer in the class of the foremost hatcheries.





Brood pond and hatching house, Sutton fish hatchery.

The State property at the Palmer hatchery consists of 233 acres of land, three houses, a hatchery building, a small experimental hatchery, an ice house, dams, pools, etc. The tract lies in a valley through which runs a brook of excellent water, formed by many springs on the hillsides. The first work was to establish a small trial hatchery, still standing, in which in the fall and winter of 1911 and 1912 a substantial number of eggs were hatched and reared in order to thoroughly test the water. One of the more important features is the possibility of acquiring additional springs, ponds and water-storage facilities should later developments warrant.

Four bass ponds, situated in the meadow below the hatchery, were practically completed during 1913; also, a dam to supply water for perch, salmon and trout at the small hatching house and 12 new rearing pools were built. In 1914 a new hatchery building, 36 by 72 feet, two stories in height, was constructed at the lower reservoir.

This hatchery is equipped in the most up-to-date and efficient manner, and is capable of handling large numbers of practically all the ordinary species of fish artificially propagated. The first floor of the building contains the hatching room and the office of the superintendent, and the second story has a carpenter shop, large storage room and bedroom for the accommodation of messengers distributing fish. An ice house of sufficient size to furnish the necessary amount of ice for the shipment of fish from the hatchery was likewise built.

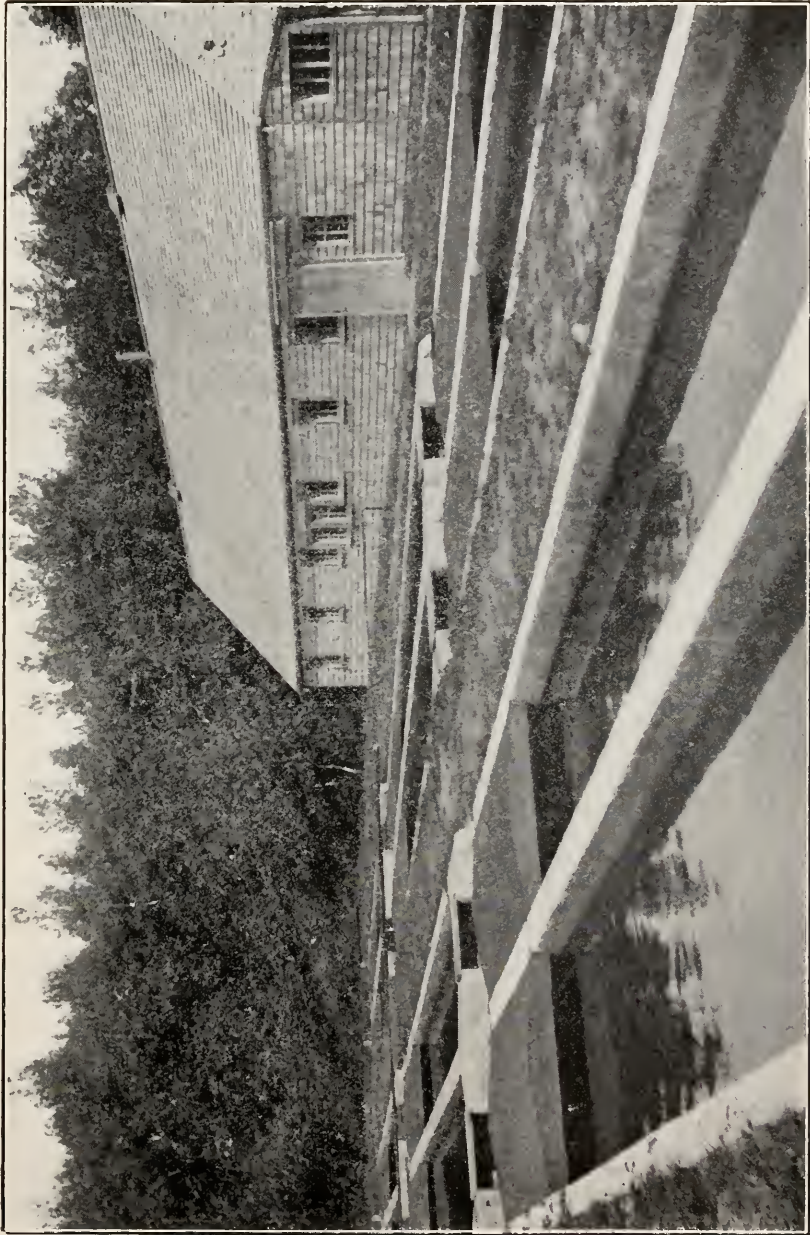
Chapter 271 of the Acts of 1911, providing \$8,000 a year for a period of five years with which to establish, equip and maintain fish hatcheries, enabled the commission to establish the Palmer hatchery. When the funds became available for this purpose the commissioners communicated with all of the deputies and instructed them to carefully investigate in their districts all possible locations for fish hatcheries. The best of the suggested locations was reported by Deputy John F. Luman. Before purchasing the Palmer property it was thoroughly inspected by two of the most prominent experts on fish culture in the United States, Dr. Tarleton H. Bean, fish culturist of the State of New York, and Mr. George Schriba of Constantia, N. Y., formerly superintendent of the New York bass hatchery, and later by Mr. Dwight Lydell, assistant

superintendent of the Michigan Fish Commission, who pronounced the Gates Brook proposition, because of the physical lay of the land and the reputation of this stream as a natural trout stream, to be one of the best locations yet seen for the purpose of rearing trout and salmon on the upper parts of the station, and for black bass lower down the stream.

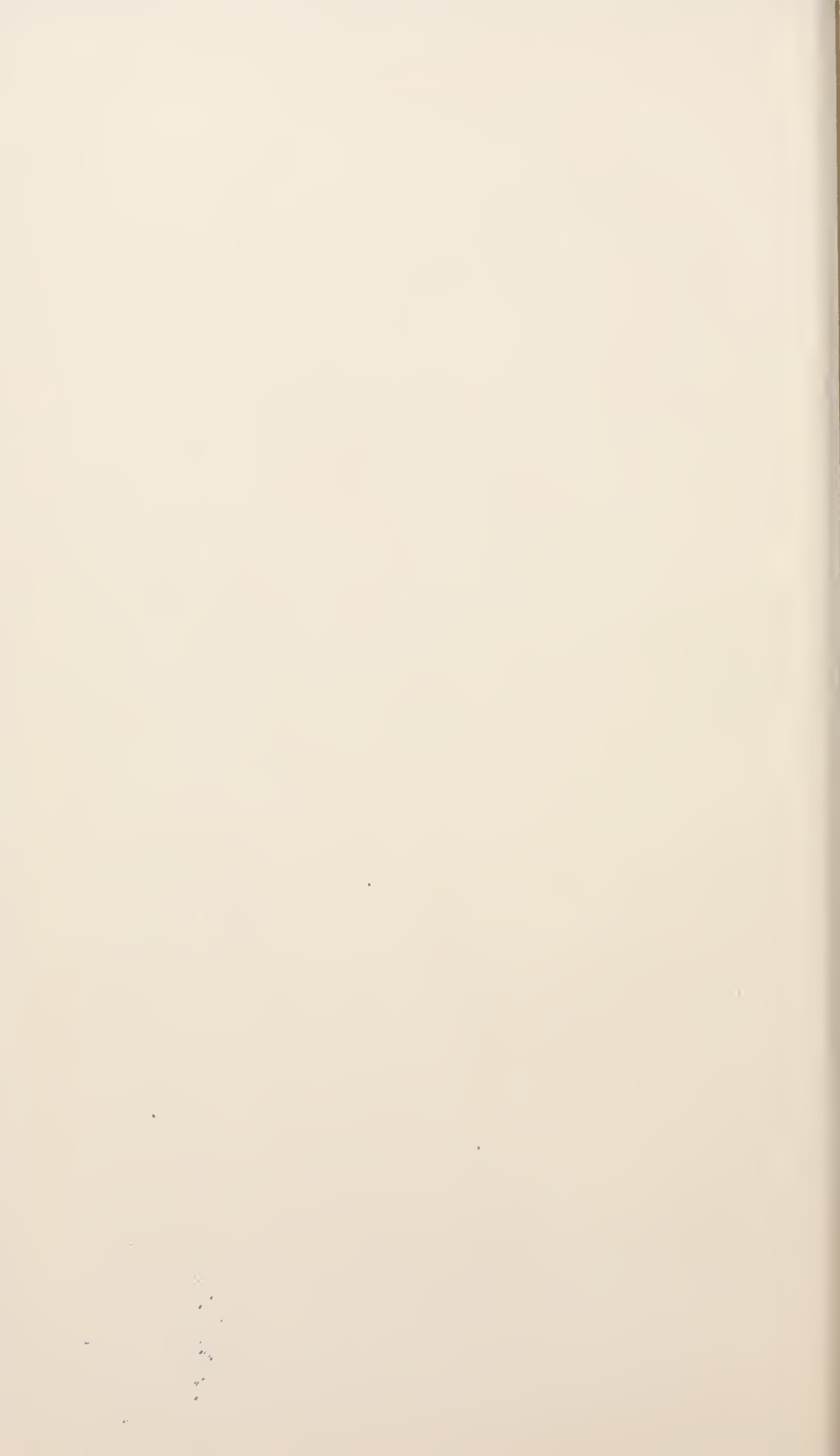
Sandwich Hatchery.—The finest trout hatchery site in the Commonwealth is located at Sandwich, Mass., and consists of two parts, one at East Sandwich, the other at Sandwich. The East Sandwich rearing station, with an ever-abundant supply of pond and spring water, should produce a sufficient number of trout eggs to supply all other State hatcheries when a modern hatching house, with a capacity of at least 6,000,000, and a large number of brood pools are constructed, thus eliminating the necessity of keeping a separate brood stock at each hatchery. The Sandwich division comprises $22\frac{1}{10}$ acres of land, on which is located a hatching house 60 by 20 feet, containing 28 single troughs, a spawning tank, egg trays, gasoline engine, meat choppers, fish cans, shipping cases, tools, etc. In the hatching house 1,400,000 eggs can be raised to the eyed stage, when they are shipped to the other stations for final hatching, and an additional 2,000,000 can be reared to the fry stage. The outside equipment consists of 18 cement nurseries, 12 intermediate ponds and 6 large cement ponds fed by two streams of water, one with an average capacity of about 80 gallons per minute, the other of about 50 gallons, in addition to 28 artesian wells flowing from 3 to 9 gallons per minute.

At East Sandwich, about $4\frac{1}{2}$ miles distant, the fish hatching property consists of $4\frac{28}{100}$ acres of land, a workshop containing water wheel, meat chopper, nets, tools, etc., small building with two spawning tanks, 38 small ponds, of which 7 are lined with wood and 4 with cement, and 39 artesian wells flowing from $2\frac{1}{2}$ to 15 gallons per minute. In addition, the Commonwealth has acquired the exclusive right to the water from a 7 acre spring water pond on the opposite side of the road from the hatchery, the water being taken from the surface through a sluiceway.

This station was considered the best commercial hatchery in Massachusetts, and before its purchase, at the request of your



Rearing pools and hatching house, Sandwich trout hatchery.

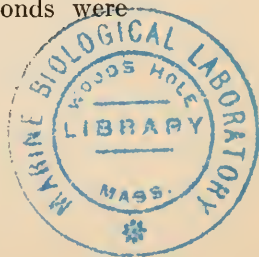


commissioners, it was thoroughly inspected by Dr. Tarleton H. Bean, fish culturist of the State of New York, who reported that the establishment of the Sandwich Trout Company's hatchery had a known capacity, and that it could furnish probably all of the fry and fingerlings needed for the waters of the State.

A survey of the premises at Sandwich and East Sandwich was made in order that the development at these stations might be conducted along a clearly defined line. In furtherance of this general plan, Superintendent Hitchings recommended that a pipe line be installed to the supply pond, that a new hatching house be built at East Sandwich and that the capacity of the Sandwich hatchery be increased by 15 new nursery ponds and 5 cement brood ponds.

Sutton Hatchery. — Owing to the fact that this hatchery is jointly connected with the Sutton game farm, it is difficult to differentiate between the work at the game farm and at the hatchery, as the assistants, four permanent and several temporary employees, are employed for both fish and bird work. The permanent men carry on the routine work, while temporary employees are employed on construction work upon the hatchery grounds.

In 1913 the tanks for raising fry and early fingerlings were covered with a roof shelter for use in the winter, thus increasing the capacity of the hatchery to 2,000,000, almost doubling the output at a cost of not over \$250. In 1914, 6 concrete troughs for holding fry and young fingerlings were built, and the foundations laid for 4 more at the upper end of the hatchery grounds. Drains of vitrified pipe were laid in the bottom in such a manner that each separate pool could be cleaned without disturbing the others. At the head of the breeding pond the stone wall was faced with concrete and the brook was walled for some distance. A concrete settling tank 8 by 12 feet was built to form a water supply for the upper hatchery, and an embankment was made to carry a line of pipe to the buildings. The old wooden walls in some of the rearing pools were replaced by concrete, and 2 new concrete ponds were built.



GAME BIRDS.

Only recently has the public begun to realize the existing danger to and the rapidly increasing importance of the maintenance of its wild life. Agriculturists now appreciate the enormous tax placed upon their productive activities as a result of the subnormal population of birds. People are awakening to the fact that the decrease of birds brings an increased tax upon all food products, for the reason that the farmer is obliged to use artificial methods to accomplish the work formerly done without expense by the birds. In addition, the cost of living is increased by (a) the unnecessary destruction of timber and shade trees by such injurious insects as were formerly controlled by woodpeckers, nuthatches and titmice; (b) the productive capacity of a community is diminished by the spread of diseases, notably malaria, such as are transmitted by certain insects, which were formerly kept under control by the myriads of small birds; and (c) more recently and directly by the vast sums of money which the New England States and Congress are obliged to spend for the suppression of the gypsy and brown-tail moths, which in Europe are kept under control by natural checks, such as disease and parasites, and particularly by pheasants, quail, partridges, cuckoos and other birds.

A normally large population of birds is not inconsistent with a dense human population, as is evidenced by the conditions in England, Germany, China and other countries, where a far larger bird population exists than in Massachusetts. In those countries every farm, every garden plot and house lot is developed as a place upon which birds may safely rear their young. Suitable and secure nesting places are provided, as well as abundant and attractive food, and particularly freedom from intrusion, either of idle human curiosity or of special enemies, such as cats, dogs, foxes, rats and squirrels. Unfortunately, under conditions which obtain in civilized countries, through human interference with nature's equilibrium, these enemies tend to increase abnormally, with the resultant diminution of bird life.

The children of the community should be the natural guardians of the birds, and must be trained in the home and in the

school to an intelligent appreciation of the privilege and duty of protecting the wild life. Myriads of birds are sacrificed to the night prowling cat, and, unintentionally, to the curiosity of the small boy. In Germany, in the valley of the Danube and elsewhere, the peasant children take particular care to prevent birds from nesting in the mowing fields and cultivated land, where the nests or young are liable to be disturbed. The ground-nesting birds are gently driven into reserved sections of the farm, which are kept free from intrusion. The nests are specially searched out and carefully safe-guarded, so far as possible, from all enemies. As a result, the number of pheasants, grouse, quail and plover raised annually in such densely populated countries as England, Germany, France and China are not only an efficient control for insect pests, but also serve as an important food supply for the people. Moreover, millions of such birds are exported to the markets of the United States, where they are sold as food. All this is made possible by the personal attention of the children, by suppression of the superfluous population of cats, rats and dogs, by reserving areas of grain and fruits for food and nesting places, and particularly by the artificial propagation of such species as readily lend themselves to these methods. We have found in Massachusetts that not alone may the pheasant be propagated, but also the bobwhite and many species of wild ducks. To this type of work increasing attention must be given, to the end that the birds may again become an important factor in decreasing the cost of living as well as make the countryside and the city park more attractive to all classes of people.

In our parks and on our private estates, in our yards, gardens and fields, sunflowers, buckwheat and other grains, as well as various shrubs and trees the fruit of which persists through the winter, must be extensively planted, especially for the birds. The spirit of unnecessary killing must be curbed, and any person who has reared annually a number of useful birds, or who has lent his personal influence to check unnecessary or unlawful destruction of wild life, should be regarded as one who has rendered distinguished civic service.

Destruction. — Man is an important factor in the destruction of game birds, the market price acting as a bounty to reduce

their numbers. As instances of this destruction may be cited the great auk, the Labrador duck, the wild turkey and the passenger pigeon, all of which formerly existed in enormous numbers, but which have been completely extirpated, largely through market demand, which encouraged their slaughter. Another instance may be cited in the case of the heath hen, of which only a small remnant now remains upon the island of Martha's Vineyard. With the passing of these species the market gunners turned their attention to the shore birds, with the result that, according to that eminent authority Prof. Wells W. Cook of the United States Biological Survey, these birds in general are reduced to less than one-tenth their number of forty years ago. The Eskimo curlew appears to be extinct, and the upland and golden plover nearly so. Formerly these shore birds existed in large numbers, but increasing price and market demand have brought about this change. Forty-three States and territories in 1912 forbade wholly or in part the sale of wild game, and of these, 19 prohibited the sale of practically all wild game. However, laws prohibiting the export of game birds are often ineffective and evaded as long as a market demand continues. Markets, where open, now encourage the illegal killing and shipping of game birds from other States, as many convictions bear witness. But the greatest destruction by the market gunners at the present time is among the geese and ducks, which are killed by thousands during the winter in the south and shipped to northern markets.

Remedial Measures. — It is our privilege to record the fact that Massachusetts citizens have participated in the wave of public sentiment which has swept over the country, and during the past five years our Commonwealth has made considerable progress in improving conditions for maintaining an adequate supply of birds. The most important steps in advance are the prohibition of spring shooting, the nonsale of wild game birds and the establishment of bird reservations, upon which birds may find not alone a sanctuary but a breeding and feeding place secure from enemies.

The Boston market is supplied to a large extent by game imported from Europe, and by means of licenses and proper tagging the market men are fully protected in their legitimate business, but from an economic standpoint the only way to

maintain the game supply in Massachusetts is by game farming. The only way to insure the perpetuation of game as a food supply is to rear the birds and animals in a state of semi-domestication, whereby, protected from natural enemies, the increase may be utilized for food and sport, without seriously diminishing the stock. Game farm methods should not only relieve the drain upon the wild stock, but also should increase the wild stock by the number of individuals which escape and return to the wild state.

Private Game Farms.—Notable progress has been made in rearing game birds at State game farms, and the same can be done on private preserves. Under chapter 567 of the Acts of 1913, a person, firm or corporation may receive a permit for the rearing of birds and quadrupeds for sale alive, and can acquire the privilege of propagating within an enclosure any species of deer, elk, pheasants, quail, European or gray partridge, wild geese, wild ducks or squirrels, which can be sold, exchanged or given away for the purpose of propagation. When sold for food, dead or alive, a second permit is required, and a numbered tag is prescribed, which is applied by the seller either before or immediately after the birds are killed. Each person receiving a permit to propagate birds or quadrupeds according to this act is required to make a written report regarding the results of the efforts at game propagation to the Commissioners on Fisheries and Game on December 1 of each year. These permits do not give the right to trap wild birds contrary to present or future laws. In 1913 a total of 566 permits were issued under the above act, 517 for propagation only and 49 for the breeding of game for sale dead or alive. In 1914, 449 permits were given for propagation and 50 for sale.

State Game Reservations.

Chapter 410 of the Acts of 1911 permitted the establishment of State bird and game preserves for the protection and propagation of wild birds and quadrupeds. This type of work should be undertaken by public-spirited citizens, upon whom rests the real initiative. The areas should be of a comparatively large size, with well defined boundaries, to insure good results, which can be obtained by the co-operation of several adjacent landowners.

State Reservations which come under Chapter 362, Acts of 1909.

INSTITUTION.	Town.	Approximate Area (Acres).
Danvers State Hospital,	Hathorne,	509
Foxborough State Hospital,	Foxborough,	103
Gardner State Colony,	Gardner,	1,600
Lakeville State Colony,	Middleborough,	75
Massachusetts Hospital School,	Canton,	65
Massachusetts School for the Feeble-minded, {	Waverley,	-
	Templeton,	100
Medfield State Asylum,	Harding,	450
Monson State Hospital,	Palmer,	288
Norfolk State Hospital,	Norfolk,	1,006
Northampton State Hospital,	Northampton,	511
North Reading State Sanatorium,	North Wilmington,	80
Penikese Hospital,	Penikese Islands,	100
Rutland State Sanatorium,	Rutland,	360
State Infirmary,	Tewksbury,	742
Taunton State Hospital,	Taunton,	352
Westborough State Hospital,	Westborough,	763
Westfield State Sanatorium,	Westfield,	175
Worcester State Asylum, Grafton Colony,	Worcester,	1,000
Worcester State Hospital,	Worcester,	-
Wrentham State School,	Wrentham,	200
Industrial School for Boys,	Shirley,	700
Lyman School for Boys,	Westborough,	300
Massachusetts Reformatory,	Concord,	258
Prison Camp and Hospital,	Rutland,	1,000
Reformatory Prison for Women,	Sherborn,	333
Industrial School for Girls,	Lancaster,	50
State Farm,	Bridgewater,	1,200
Massachusetts Agricultural College,	Amherst,	400
Hospital Cottages for Children,	Baldwinville,	-
Perkins Institution and Massachusetts School for the Blind.	Watertown,	34
Soldiers' Home,	Chelsea,	7
Greylock Reservation Commission,	Adams,	8,160
Deer Hill Reservation,	Plainfield and Cummington,	259
Mount Everett Reservation Commission,	Mount Washington,	800
Mount Sugar Loaf Reservation,	Deerfield,	90
Mount Tom,	Holyoke and Northampton,	1,800
Wachusett Mountain State Reservation Commission,	Princeton and Westminster,	1,500

STATE BIRD AND GAME PRESERVES.

Under Chapter 410, Acts of 1911.

	Area (Acres).
Hubbardston,	3,000
Fairhaven, Sconticut Neck,	1,000
Topsfield,	1,000
Brookfield,	1,200
Marshfield,	5,000
Hingham,	5,000
Dedham-Needham, Dover-Westwood,	2,000
Wayland and Sudbury,	2,000
Sharon,	1,500

Under Chapter 178, Acts of 1902, and Special Acts.

Wilbraham,	209
Martha's Vineyard,	3,000
Sutton,	23
Sandwich,	20
Adams,	2
Palmer,	233
October Mountain,	12,000
Mark W. Potter,	1,000
Third Cliff,	50

Summary.

Under chapter 362, Acts of 1909,	25,370
Under chapter 410, Acts of 1911,	20,500
Reservations and hatcheries,	16,537
Total (approximately),	62,407

State Game Farms.

Notable progress has been made in rearing game birds at Sutton, and within the last three years additional stations have been equipped at Wilbraham, Marshfield, Norfolk, Sharon and Sandwich, while the reservation on Martha's Vineyard has been further developed. An increased number of game birds must come through more protected reservations and extensive artificial propagation, and ultimately the same methods must be extended to certain insectivorous birds.

The State game farms in Massachusetts are situated in different parts of the Commonwealth. The Wilbraham game farm furnishes a distributing center for the central and western

parts of the State, and the Sutton game farm near Worcester for the middle and eastern parts. At Sandwich on Cape Cod, where the facilities for raising quail and grouse are more favorable than elsewhere, a new game farm has been located within the past year. On Martha's Vineyard is a reservation of 600 acres in the center of the island, where attempts are being made to save the last remnant of the eastern prairie chicken, or heath hen, by protecting and keeping the birds in a state approaching as nearly as possible to the wild. Another type of game farm is the experimental station at Sharon, where numerous observations are being made on the propagation of pheasants and quail. Still another type, the Norfolk game farm, is located on the State Hospital Reservation, and suggests a method whereby similar State land, otherwise useless, may be utilized without additional cost, and the inmates receive a vocational training by assisting in the work. Likewise, at Marshfield, a game farm has been started on a large reservation. The development of all of these stations has been according to a definite plan, and such purchases of land as have been made from time to time have been for the purpose of improving their natural resources and permitting their healthy growth.

Rearing Methods. — Two methods for the rearing of game birds, the open and the closed, have been followed at the State hatcheries in order to determine, if possible, the best conditions for each particular species. It has been found that quail and grouse may yield better results if separated from other birds, as has been demonstrated at Sandwich on Cape Cod. The Wilbraham game farm furnishes an example of the open system of pheasant rearing, owing to its extensive area, and to the excellent facilities for allowing the birds to roam at large. Quail, pheasants and wood ducks are raised on a more intensive method at the Sutton hatchery. We have, therefore, under observation the open or extensive system, in which the young birds are put out as soon as possible in large fields, and the more intensive method of rearing the birds to adult age in small enclosures. The open method causes a much greater loss from predatory vermin, and greater quantities of the birds escape, which, in a way, is offset by the hardy nature and free-

dom from disease of the surviving birds. Results obtained with pheasants and quail seem to favor the open method, but for wintering the birds do nearly as well in the smaller cages as in the larger enclosures, possibly owing to greater care. The surviving birds in open enclosures, provided they are fed during the winter, seem somewhat hardier, but the average number of eggs is less than with birds more closely confined.

For rearing birds certain localities are more favorable than others, and great judgment is required to place the birds, especially the young, in a territory where there is sufficient protective cover, and where the ground will be such as not to render them prone to disease. The two chief drawbacks to the rearing of game birds in large numbers are disease and enemies. The former is prevalent among all birds which are kept in close quarters, owing to lack of vitality, and opportunities are favorable for disease to spread swiftly in segregated flocks. On the other hand, the vermin, such as hawks, owls, crows, weasels and rats, as well as dogs, foxes, raccoons and particularly hunting cats, are to be feared in open rearing. Homeless cats, dependent upon their own resources, soon develop the hunting instinct, and are an important factor in game extermination. Efficient legislation backed by public opinion is necessary to eliminate this evil.

The most important factor in the rearing of birds is proper feeding, especially during the breeding season and during the winter. It is pre-eminently important that the birds have sufficient food and shelter in winter. Probably the largest percentage of deaths among young birds is due to dietary indiscretions. A variety of foods should be used in raising young birds, and beginners in bird culture are especially warned against the danger of overfeeding, which renders both young and old susceptible to serious diseases. Activity is indispensable for the well-being of the birds, and forcing them to work for their food in any way is of advantage inasmuch as it provides the requisite normal amount of exercise. In feeding young birds the food should be given in small quantities and be absolutely fresh, so that the birds may not receive anything sour and decaying.

At the hatcheries various experiments have been conducted

and considerable data accumulated concerning the raising of birds, for the personal guidance of the superintendents and for the benefit of individuals interested in the rearing of birds. The methods of bird culture, some of which are only in the experimental stage, have been developed by such experiments, and it is an important duty of the State hatcheries to conduct such experimental work, in order to determine the most efficient and economical means of producing game birds. Directions regarding the feeding and care of the birds will be sent on application to persons interested.

The Wilbraham Game Farm.—In 1912 the only station operated by the State was situated on a limited area of land in the town of Sutton. The need of more and larger game farms was imperative to increase the production of game birds, since Sutton was producing nearly its maximum yield. The solution of this problem was found in the selection and establishment of the Wilbraham game farm, which not only offers opportunity for raising birds on a large scale, but possesses the advantage of indefinite expansion in the production of game birds. The game farm is located in the southwest corner of the town of Wilbraham, about 2 miles from the Wilbraham post office, and though easily accessible is sufficiently isolated from a large population to prevent numerous visitors interfering with the raising of the birds. Its location is such as to provide an ideal distributing center for that part of the State.

Since its establishment in 1912 the Wilbraham game farm has been in the early stages of development and growth. The main efforts of the past three years have been devoted to the establishment of a firm foundation for future work, and the greatest efforts have been expended on construction work, with the result that at the present time the hatchery is just beginning to demonstrate its productive capacity and possibilities for future development.

The land for the Wilbraham game farm was not purchased outright, but 109 acres were leased from C. A. Atchison, John H. Reader and Henry Clark for a period of five years, beginning Jan. 15, 1912, and 100 acres from R. Bostick for a period of three years from Nov. 11, 1912, with an option of purchase at the expiration of the lease. The policy of this department has

been to purchase no land until it had been thoroughly tested for its suitability for the work. In 1913, 132 acres of land, two houses, two barns and two sheds were purchased by the Commonwealth after the estate had shown that it was especially suited for the propagation of game birds. In addition, privately owned land adjoining the land of the Commonwealth was rented. The locality in which these adjoining tracts of land were situated had long been a noted hunting ground comprising stretches of sandy soil intermingled with substantial growths of timber and desirable swamp land, which formerly furnished fine cover for ruffed grouse, quail and woodcocks. This territory has been adapted for hatchery purposes by the erection of buildings necessary for an up-to-date game farm.

On Dec. 1, 1914, the buildings on the main hatchery grounds consisted of a remodeled farmhouse for the superintendent and his assistant, a workshop, two old barns, and other minor buildings useful on a bird farm. Joseph H. Mosher was placed in charge as superintendent, and under his able direction construction was carried to its present state of completeness, through the building of a modern water system, large enclosures, rearing pens and extensive covers. At the present time four employees, viz., a superintendent, a first assistant and two men who are hired by the day, carry on the routine work of rearing the birds and working the farm.

East Sandwich Game Farm. — In 1914 the East Sandwich game farm was established on 50 acres of leased land. Work was started by Supt. Harry E. Torrey, an expert breeder of quail and grouse, on land particularly adapted to the propagation of these two species. The necessary wild quail and grouse were first trapped in order to establish native breeding birds of the best quality, and thereby avoid complications by introducing birds from outside the State.

While engaged in the work of trapping his brood stock Superintendent Torrey was busily engaged in the construction of stationary yards and movable breeding pens for the quail. Ten acres of thicket and open land, with several knolls and hollows, were completely enclosed by a 6-foot fence of wire netting. The character of this land was such as to afford shelter from the cold north and northwest winds in rough

weather, and an abundance of shade was provided by assorted groups of deciduous and evergreen trees. A duck yard of 6 or 7 acres of marsh and upland, comprising grass, rushes, bushes and various kinds of trees, was also enclosed,⁴ and a suitable house for raising bantams was provided.

The work at East Sandwich is as yet in its infancy, but its favorable location and natural resources indicate that this game farm is one of the best places in Massachusetts for the rearing of quail and grouse. Under the able and efficient care of Mr. Torrey it should develop into a most productive game-bird hatchery.

The Sutton Game Farm. — Game bird propagation, which was started upon the property of the Sutton fish hatchery in 1902, has steadily assumed increasing proportions. In 1912 the experimental work of testing hatching methods and rearing new species in order to comply with requests for advice from a constantly increasing clientele interested in this work claimed much attention. This work necessitated a corps of four trained and several temporary assistants, as it is quite impracticable to attempt experimental work with an untrained force, or even with a force subject to frequent changes.

In 1912 a camp was established which provided living and sleeping accommodations for the permanent employees and a laboratory for investigations on bird diseases and for experiments in rearing young birds. In 1913 the construction work was further extended by the erection of large pens for the pheasants and mallard ducks, the latter being built upon the brook. An additional area of 13 acres was purchased, which included on the south a strip of pasture and upland suitable for quail, while the lower part, sloping gradually to a brook, afforded an excellent breeding place for ducks, as did also another strip of swamp land on the east, the higher portion of which was suitable for quail and pheasants. Adjoining the eastern strip were several acres of hillside covered with underbrush and a thickly wooded swamp well watered by springs, forming an excellent covert for wood ducks. Steps were immediately taken to render this land available by erecting fences and pens. Six duck yards were supplied with running water, and 10 acres of hillside were enclosed. In 1914 the im-

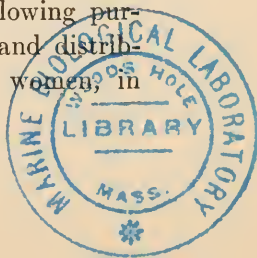
provements were largely directed toward the construction of new pens of heavy creosoted material, or, whenever practicable, of concrete.

Martha's Vineyard Game Farm. — The reservation on Martha's Vineyard was established pursuant to chapter 504, Acts of 1907, to preserve the last remnant of the heath hen. It is a sad commentary on the thoughtlessness of the American people that a bird once so numerous all over the eastern States should eventually have to take up its last stand on this island in the Atlantic Ocean.

The reservation, which is situated southeast of Vineyard Haven, comprises 600 acres of land on which is situated a modest dwelling house and a small barn, which were purchased in 1908. The Commonwealth also holds under lease, expiring June 1, 1917, with an option of purchase for \$10,000, an additional tract of 1,000 acres, on which are located two houses and various outbuildings. This latter tract is held pursuant to chapter 271 of the Acts of 1911, at a rental of \$400 per year.

Extensive and systematic improvements are continually being carried on with a view to making the area more attractive to the birds. A large portion of this tract and practically all of the surrounding country is covered with a dense growth of scrub oak, with a flooring of grass and plant life of an inflammable nature. The first step in the development was the installation of a system of fire stops by clearing long lanes 70 feet wide. In these lanes all trees and bushes were removed and the ground turned over with a disk harrow often enough to destroy the floor covering. Under Supt. William Day, who took charge of the reservation in March, 1913, the farm is being thoroughly cultivated. In addition, a small pond on the reservation, together with a wide strip of land around it, has been enclosed for geese and ducks.

Norfolk and Sharon. — Inasmuch as the rearing of birds was still in the experimental stage in 1912, and observations were necessary for the proper application of new methods, it seemed advisable to establish one or more small experimental stations where observations could be carried on for the following purposes: (1) to secure new facts of value in rearing and distributing birds; (2) to train persons, both men and women, in



feeding and propagating birds; (3) to determine the comparative advantages of small rearing plants compared with larger game farms; (4) to make observations upon the value of the pheasant as a farm bird; (5) to furnish a small demonstration plant such as could be established on any farm without expensive buildings or yards; and (6) to give the public an opportunity to view the birds and the methods of handling them. In no sense was it attempted to have a "model" plant, but only one such as would be typical of a simple farm. The first of these was started at Sharon, where it would be most convenient for the personal observation and direction of the chairman of the commission, who has long had practical experience in bird propagation.

The Sharon game farm, entirely distinct from the Sharon reservation, was established in 1912, the reservation two years later, in 1914. The pens and range occupied by the birds during the breeding season cover about 10 acres. The chairman of the commission has devoted considerable time to experimental work here, furnishing, without charge, land, workshop, henhouses, brooders and incubators, only the movable equipment, such as coops, wire fences and tools, being furnished by the State. In 1912 Mr. Fred R. Cushing was put in charge of this game farm. A large pheasant pen, practically animal proof, in which the birds could run at large when a week old, was constructed in addition to 37 large and 30 small coops, with the requisite equipment for rearing quail and pheasants.

As a further extension of the general plan, it was contemplated to place at various State institutions a similar plant, where the patients would have opportunities to see the work carried on, and by active participation learn the methods of handling and propagating birds, in the expectation that some of the most capable would thereby be introduced to a new aspect of life. The first of these to be established was at the Norfolk State Hospital, where 1,000 acres were set aside as a game farm. As a general working proposition, it is arranged that the fish and game department shall furnish materials for work and supervision, the labor being furnished entirely by the institution. In case it seems advisable, similar plants may be established at other State institutions as ways and means permit.

The Norfolk game farm was practically started on June 20, 1912, when Supt. Henry K. Gates took active control of the propagation of birds. The first location, in an unused garage on the grounds in the rear of the residence of the assistant physician, was only tentative. The equipment at the station when taken in charge by Superintendent Gates consisted of only 12 pheasant pens containing temporary nests. At the present time these difficulties have been surmounted by the erection of a sufficient number of pens and yards, equipped with proper hatching facilities.

Pheasant.

For the first time since 1907 an open season on pheasants was granted by the Legislature in 1914, and farmers were given the privilege of shooting birds found damaging crops, provided that they made a written report within twenty-four hours to the department of fisheries and game. According to law the commissioners declared an open season on pheasants in seven counties. The birds, protected for so long a time, had become tame, people even feeding them in their yards. At the opening of the season the action of certain hunters in shooting pheasants near houses rather than going into the woods for the wilder birds caused considerable hard feeling, which resulted in a violent newspaper agitation against the commissioners for declaring an open season. Owing to the danger of forest fires from lack of rain the Governor declared a closed season for three days, from October 14 to 17. On Oct. 31, 1914, a public hearing was given by the Governor at the State House, at which arguments for and against an open season were advanced by many hunters and other citizens.

The results of the open season are shown in the following table, compiled from the returns of the hunters as required by law. Undoubtedly many pheasants were killed for which no returns were made, but the comparison between the counties and the different days are valuable. The large number, 2,034, killed the first day is due to the fact that October 12 was a holiday, and to the tameness of the birds after years of immunity. The returns for the subsequent days show the increasing wildness of the birds.

FISH AND GAME.

Summary of Open Season on Pheasants, 1914.

NAME.	Totals.	Males.	Fe- males.	OCTOBER.											
				12.	13.	14.	15.	16.	17.	19.	20.	21.	22.	23.	24.
Barnstable, .	31	15	16	6	4	1	-	-	1	-	1	1	-	4	-
Berkshire, .	477	320	157	126	59	5	1	2	19	26	24	16	21	10	18
Essex, .	2,583	1,684	899	693	258	46	5	5	115	119	122	108	85	72	131
Middlesex, .	467	295	172	74	41	11	1	1	29	29	19	5	16	12	35
Norfolk, .	2,832	1,854	978	625	197	40	3	2	143	121	159	126	120	90	158
Hampden, .	655	408	247	150	49	23	-	3	25	29	41	43	36	20	38
Worcester, .	1,898	1,229	669	360	162	32	2	2	66	90	90	91	55	71	119
Total, .	8,943	5,805	3,138	2,034	770	158	12	15	398	414	456	390	333	279	499

Summary of Open Season on Pheasants, 1914 — Concluded.

NAME.	OCTOBER — <i>Con.</i>						NOVEMBER.									
	26.	27.	28.	29.	30.	31.	2.	3.	4.	5.	6.	7.	9.	10.	11.	12.
Barnstable,	1	2	—	1	—	—	2	2	1	—	—	2	—	—	—	2
Berkshire,	9	10	5	13	7	12	7	4	12	7	7	12	9	4	12	20
Essex,	65	50	42	50	37	66	32	40	38	44	47	61	48	45	82	77
Middlesex,	27	12	6	7	10	28	12	9	13	8	8	14	8	7	9	16
Norfolk,	83	68	59	56	62	100	55	56	36	39	42	93	44	61	77	117
Hampden,	20	15	9	18	9	20	8	14	7	9	14	10	8	10	11	16
Worcester,	60	50	51	51	29	78	32	42	36	41	32	74	31	30	46	75
Total.	265	207	172	196	154	304	148	167	143	148	150	266	148	157	237	323

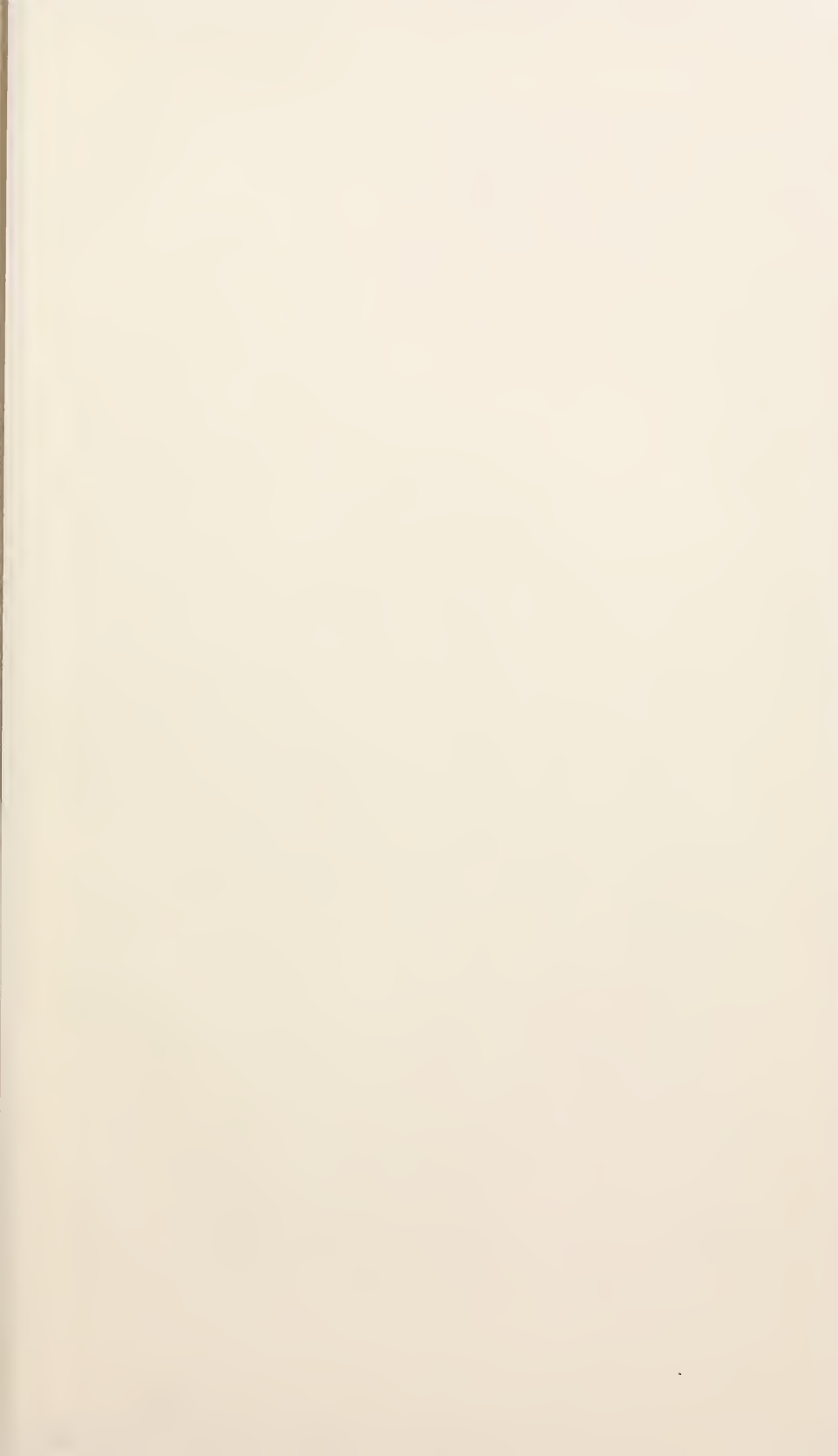
The late Edward A. Brackett in 1894 was the first person to start the propagation of pheasants in Massachusetts, and at Winchester devoted considerable time to perfecting the methods of rearing this bird. In 1902 provisions were made for the pheasant propagation at the Sutton hatchery, which, together with Winchester, for years supplied the coverts of the State with this game bird. At the present time pheasants are raised at Sutton, Wilbraham, Norfolk and Sharon, as well as on many private estates and reservations.

Quail.

Our native game bird, the bobwhite, is reported to be on the increase in the south and southeastern sections of the State, although a few are found in the northern part. Definite information as to the number of these birds is difficult to obtain, owing to a lack of standards of comparison between different localities. These valuable little birds were nearly exterminated during the winter of 1903-04, and people, especially farmers, now see the importance of their protection. A word of commendation should be given for the cheerful response of citizens to the call last winter to feed the quail, pheasants and other birds during the period of deep snow and ice. Sportsmen's clubs, bird societies, boy scouts and private citizens joined in the movement, which enabled many birds to reach the breeding season strong and healthy. An excellent protection is afforded the birds by placing a few poles from the south side of a stone wall to the ground and covering them with boughs. In such case an opening should be left so that if surprised by cat or fox they might have a chance to escape, and grain, grit and chaff should be placed near these shelters. This fine bird is raised at the Sandwich and Sutton game farms.

Ruffed Grouse.

Reports indicate that these birds are on the increase in the north and northwestern sections. The open season on pheasants in 1914, in addition to the indirect protection afforded by supplying another source of game, made it difficult to locate the grouse. In the counties that did not have an open season on pheasants substantial numbers of ruffed grouse were taken, but evidently a good number survived. Comparatively few





Mallard ducks, Wilbraham game farm.

complaints concerning the damage to crops by this bird have been sent in by farmers. In one instance on Cape Cod strawberry beds were slightly damaged, and in western Massachusetts a more serious injury was reported by two fruit growers, who claimed that the grouse stripped large numbers of buds from apple trees.

The ruffed grouse is probably the most unsatisfactory and the hardest of our game birds to raise in captivity. The rearing of this bird is as yet in the experimental stage, and it will probably take some years before a satisfactory method can be obtained. Supt. H. E. Torrey, who has had previous experience in rearing ruffed grouse, started hatching these birds at East Sandwich in 1914.

Ducks.

The increased number of ducks breeding in Massachusetts during the past two years has been markedly noticeable, and many favorable comments have been made in favor of the prohibition of spring shooting. Almost every section reports that they are gradually coming back to nest. For the sake of illustration may be mentioned one incident at a certain pond in Bridgewater. In previous years the few birds which came in the spring were either killed or disturbed, so that none were ever reared there, but in 1913, just previous to the open season, nearly 400 young ducks were reported in that locality.

The rearing of ducks began at the Sutton game farm in 1912, when several pairs of mallard, wood and black ducks, as well as a few widgeons, redheads, pintails, Australian eyebrows and gadwells were purchased. Of these, the mallards proved the easiest to rear successfully, although some progress was made with the wood and black ducks. In 1913 the rearing of mallard ducks commenced in earnest. The same success in rearing mallards continued in 1914, but few results were obtained from other ducks.

Mallard ducks were first bred at Wilbraham in considerable numbers in 1913. The birds were confined, until after the laying season, in pens 50 by 50 feet, the brush providing a place for concealment and the lowland the necessary water. Later they were allowed a wider range in order to furnish them with more varied food.

Song and Insectivorous Birds.

Reports indicate that these valuable assets to the State are not showing the desired increase. The spraying of orchard and forest trees may be in part responsible. Trees, berries or insects which have received the arsenate of lead spray are often fatal to birds, especially the young. Drinking pools in the sprayed areas claim their share of the victims. Stray cats and dogs which are allowed to run during the nesting season also add to the destruction.

Heath Hen.

The eastern pinnated grouse or heath hen, locally called "heth'en" on Martha's Vineyard, is one of the most interesting birds in the world, from the fact that it is the contemporary of the great auk, Labrador duck, passenger pigeon, Eskimo curlew and Carolina parrotlet, and, like them, appears to have been marked for extirpation at the hands of man, but now gives promise of perpetuation. It was formerly abundant from Cape Ann to Virginia, especially in the States of Massachusetts, Rhode Island, Connecticut, New York (particularly on Long Island), New Jersey, and probably Maryland and Delaware. The last record in the Connecticut valley in Massachusetts was in 1813; in 1824 it was no longer common around Boston; in 1844 it probably became extinct on Long Island; about 1848 it disappeared from Cape Cod; and the last bird on the mainland was shot near Barnegat, N. J., in 1869.

Various attempts have been made at restrictive legislation. New York was the first to recognize the danger of extinction, and in 1785 made a close season from April 1 to October 1. New Jersey, Massachusetts and Long Island followed, but in Massachusetts the State law of 1842 provided that the law for the preservation of this grouse or heath hen might be suspended by the towns, and such action was usually taken. From 1890 a completely closed season was in force, but until 1905 there were no systematic attempts to enforce the law, and the price secured by sale of the birds was sufficiently attractive to encourage violations. In 1906 the penalty for violation was raised from \$20 to \$100. By an act of 1907 the Massachusetts Fish and Game Commission was authorized to acquire land by right of eminent domain as a refuge for the heath hen; to

provide mounted game warden service to prevent violation of the game laws; to guard against forest fires; to construct and maintain fire stops; to furnish food in inclement weather; and to kill feral cats and other vermin which prey upon the birds. Through the co-operation of the towns of Tisbury and West Tisbury, the National and the Massachusetts Audubon Societies, the Middlesex Sportsmen's Association and about twenty-five private individuals nearly \$2,000 was pledged to purchase land and to assist in this work.

In 1880 Mr. Brewster, who distinguished this bird from the western type, estimated that from 120 to 200 birds inhabited about 40 square miles on Martha's Vineyard. As is well known, these birds resort to special places in the spring for their courtship. These particular places on Martha's Vineyard were ascertained, and on May 1, 1906, a careful simultaneous observation at these three places disclosed but 21 birds, so near at that time was the species to extirpation. In May, 1907, actual count of the flocks definitely located in various sections of the range gave 77 different individuals.

Since 1907 the number of birds has varied from time to time, but in general there is a decidedly upward tendency, so that at present there are probably as many as 1,000 birds on the island. It was possible last spring to see 150 birds at once, and flocks of from 30 to 50 are frequently observed.

The chief enemy of the heath hen on Martha's Vineyard is the marsh hawk, possibly associated with the fact that the island is closely covered with a dense growth of scrub oak and other brush, making mice difficult to capture. The marsh hawks have thus been compelled to turn to more available prey, and the extensive destruction of these birds is merely the result of a perverted appetite. Investigation of 43 stomachs of marsh hawks by the United States Biological Survey disclosed the important fact that all but 4 contained remains of heath hens or song birds. In one instance the nest of a marsh hawk contained the remains of 1 flicker and 11 heath hen chickens. Telephone wires have been responsible for the destruction of several heath hens, 3 birds thus killed or injured having been found in the past year; but one of its greatest enemies is the domestic cat, which, abandoned by the summer cottagers, wanders into the interior of the island.

The future of this bird is somewhat problematical. That it can be saved from extinction, barring an epidemic or unusual disaster appears to have been demonstrated. The most interesting result of the work, which has largely consisted in the development of a typical farm in the center of the reservation, where the birds could find an abundance of food and relative freedom from enemies, has been the fact that even from a small number of birds rather rapid increase may be secured.

The efficiency of these birds as insect destroyers was demonstrated by the fact that in 1914, when the grass and corn on the rest of the island were practically destroyed by an incursion of army worms, our reservation presented a green oasis in the desert. The application of the methods adopted here promise success on similar reservations as a means of saving the remnants of the various species of grouse and allied birds in the middle and western States, notably the sage cock, the sharp-tail, pinnated and other grouse. The problem for the people to determine is whether saving the remnant of these birds, with the possibility of restoring them to suitable localities where they may again be naturalized and maintained, is worth while.

Deer.

Deer are becoming more numerous in all sections of the State, although many are annually killed by farmers, dogs, railroad trains, trolley cars, and even automobiles, in addition to the number killed in open and closed season. This increase through protection has caused considerable trouble to the farmers whose crops have been damaged, with the result that the State in some instances has had to pay large damages. However, the open season for hunting and the privilege of killing deer damaging crops have done much to bring about more amicable relations between hunters and farmers.

Damage to Crops. — The following quotation from the collections of the Massachusetts Historical Society, 2d series, Vol. 4, footnote to page 284, is of interest as the first record justifying the shooting of deer damaging crops: —

About the year 1730, John Rider of Plymouth killed three deer at a shot in that town. It was in a summer season, in a rye field. . . . It was out of season by law to kill deer. The Superior Court, then in session in that town, excused the man on the spot, it being in protection of his standing grain.

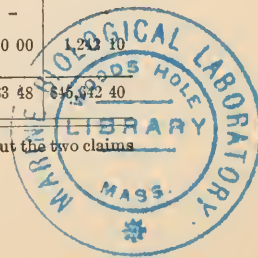
A large number of deer killed while damaging crops are reported from remote districts, away from electric and railroad accommodations, making it imperative for the deputy who is to investigate the case, according to the requirements of the law, to hire a team or automobile. In this way several hundred dollars of the appropriation are used each year, and under the existing laws there is no apparent way to lessen this outlay. The following tables give the statistics on deer in detail for the past three years: —

Summary and Comparison of Deer Statistics.

	1907.	1908.	1909.	1910.	1911.	1912.	1913.	1914.
Deer seen,	1,298	2,035	1,594	2,582	1,608	1,120	872	523
Seen chased by dogs,	114	120	71	26	10	13	5	4
Seen damaging crops,	85	100	227	358	242	220	153	214
Shot illegally,	40	36	49	64	30	23	13	5
Killed by trains and trolley cars, .	25	60	55	50	25	35	14	25
Dead from other causes (dogs, drowning, etc.).	47	83	82	157	77	126	109	118
Shot while damaging crops, . . .	16	17	198	327	232	313	195	212
Total killed in open season, .	—	—	—	1,281	1,270	1,231	1,596	1,312
Total wounded in open season,	—	—	—	101	56	53	34	21

COUNTIES.	DEER SHOT.				DAMAGES BY WILD DEER.			
	1912.	1913.	1914.	Total.	1912.	1913.	1914.	Total.
Barnstable,	—	31	33	64	\$149 25	\$1,587 00	\$147 00	\$4,883 25
Berkshire,	182	248	231	661	347 00	442 50	476 50	1,266 00
Bristol,	81	53	32	166	770 00	297 00	173 50	1,240 50
Essex,	68	37	12	117	382 05	287 00	243 85	912 90
Franklin,	203	227	242	672	5,523 25	3,846 72	3,644 21	13,014 18
Hampden,	179	242	194	615	2,055 70	2,401 15	1,786 87	6,243 72
Hampshire,	184	266	226	676	1,720 43	1,644 58	1,126 85	4,491 86
Middlesex,	88	77	40	205	887 00	1,541 50	418 50	2,847 00
Norfolk,	—	23	16	39	294 25	184 00	126 00	604 25
Plymouth,	—	78	48	126	261 50	562 34	61 25	885 09
Worcester,	246	305	238	789	2,566 50	2,606 10	838 95	6,011 55
Unclassified,	—	9	—	9	—	—	—	—
Fees to appraisers and chairmen.	—	9	—	9	725 20	1,576 90	940 00	3,242 10
Total,	1,231	1,605	1,312	4,148	\$15,682 13	\$19,976 79 ¹	\$9,983 48	\$45,642 40

¹ Two claims included in this amount aggregate \$4,404.20. Average cost without the two claims for \$4,404.20 is \$28.96.



Summary and Comparison of Deer Statistics — Concluded.

	1912.	1913.	1914.
Total number of claimants,	615	540	331
Average cost per claimant,	\$25 45	\$37 00+	\$30 16
Smallest amount received,	1 00	1 50	40
Largest amount received,	759 00	2,265 00	871 68

Fur-bearing Animals.

Since the silver and black fox industry in Prince Edward Island has been given such a boom a number of persons have requested information about breeding wild animals in Massachusetts. Very little appears to have been done with our native fur bearers, for example, the otter and mink, owing to their scarcity. A company for the rearing of silver and black foxes is now established.

Foxes. — Foxes are reported numerous, and seem to be increasing most rapidly in sections where game birds are abundant. Unquestionably much damage is done to our native game birds by these animals.

White Hares. — In March, 1914, 44 white hares were liberated in the swamp of the Wilbraham game farm. At regular intervals, apples, turnips and grain were placed on the edge of the brush. Later in the year 18 were distributed and others were liberated on the west side of the valley in the Hoosac range and upon the Greylock Reservation. When these animals multiply sufficiently to stock the coverts of the State they should prove a most valuable game asset for our sportsmen.

BIOLOGICAL INVESTIGATIONS.

The report of the biologist of the Commission, Dr. David L. Belding, follows: —

Dr. GEORGE W. FIELD, *Chairman of Commissioners on Fisheries and Game, State House, Boston, Mass.*

SIR: — I herewith submit the general report of the investigations of the biological department during the years 1912, 1913 and 1914 and a special report upon the systematic stocking of inland waters. The subject-matter has been grouped with reference to the various investigations, rather than in chronological order.

General Report.

Introduction. — In many respects the most fundamental and therefore necessary activity of a State fish and game commission is the research work of its biological department. It is the criterion by which the essential efficiency and progress of your commission is judged by other States, and the benefits resulting from the investigations are not merely limited to Massachusetts, but, through correlation with other States, are of national importance, for instance, experimental work upon the shellfisheries. Only through such investigations can your department of fisheries and game hold that reputation and standard of progress which Massachusetts has ever endeavored to maintain.

It is a self-evident fact that methods, however efficient in the past, when obsolete must be supplanted by new systems. Every branch of the world's activities has to advance or be swallowed in the maelstrom in the struggle for existence. In the same manner a State department of fisheries and game, to develop, must constantly advance by improving its methods, by correctly diagnosing the problems involved in its activities and by disseminating this information for the education of the public. These results can be achieved only by definite and discreet experimental work along necessary lines. This type of service the biological department renders to the Commonwealth.

The biologist is the pioneer who blazes the trail and indicates possible lines of developing natural resources. His duties are wide and varied. In one sense he is the real efficiency man who tests the value of the present methods of rearing fish and game, and as the result of these experiments institutes improvements. He studies the life history and the habits of the fish and the game, and then brings the application of this scientific knowledge to bear upon the solution of economic and commercial problems. The need for experimental work is constantly increasing, and many opportunities for more intelligently conserving our natural resources in fish, birds and animals are continually presented by such efforts.

The investigations of the biological department have been conducted upon various phases of fishery development, both salt and fresh water, and upon certain problems in bird propagation. Several problems, some now complete, others still unfinished, have been studied during the past three years. Suitable provision for publication of results of scientific investigations upon fish and game life should be made, and the money apportioned for the annual report should be ample and sufficient to cover all the numerous phases of the work. Otherwise, the decidedly beneficial results of such work cannot be brought quickly to the attention of the public, and a large number of people thereby cannot obtain information that might be of immediate financial benefit. Since the results of the investigations of the past three years, in all probability, will be published later in special reports, the following list may be of benefit to readers who are interested in fish and game propagation: —

1. A report upon the life history, growth and culture of the soft clam (*Mya arenaria*).

2. The food of the economic lamellibranchiata mollusks, including a brief study of the value of certain Massachusetts waters for the production of shellfish.

3. A shellfish compend, which gives briefly the practical problems of quahaug, clam, scallop and oyster culture.

4. The fresh-water ponds of Massachusetts, their natural conditions for the sustenance of fish life, their possibilities of development, and their adaptability for stocking with food and game fish.

5. The trout brooks of Massachusetts, including a brief description of the more important water systems of the Commonwealth, with a plan for systematic stocking and development of their latent and decadent possibilities for food production.

6. The fisheries of Buzzards Bay, presenting various information concerning the methods of increasing the supply of food fish, with special emphasis upon trap fishing as a basis for subsequent legislation.

7. The Massachusetts alewife fisheries, their decline, present condition, and a proposed plan for re-establishment.

8. The diseases of game birds, comprising observations upon various types of infections in Massachusetts birds.

Assistants. — Roy S. Corwin of Williams College served as an efficient assistant biologist for the years 1912 and 1913, devoting his entire time to biological work, with the exception of two months, January and February, 1913, when he was engaged in fish culture work at the Sandwich hatchery. During the summer of 1912 the temporary assistants were William G. Vinal and Howard Reynolds of Harvard College, and George F. Hopkins of Bridgewater Normal School. These men were principally engaged in the examination of the fresh-water ponds of the Commonwealth. In 1913 the temporary assistants were William G. Vinal, George F. Hopkins and Capt. Clifton Eldridge of Harwichport. The chief work for the summer of 1913 was an investigation of the fisheries of Buzzards Bay. Arthur B. Merriam of Boston University, under the immediate direction of the biologist, conducted an investigation of bird diseases at the Sutton hatchery. In 1914 Leslie J. Gilbride of Boston acted as temporary assistant. The employment of the temporary assistants continued only for the months of June, July and August, since the majority of these men were teachers. With the exception of the services of Mr. Corwin, up to Jan. 1, 1914, for the past three years the biologist has conducted the work alone during the greater part of the year, only obtaining assistants during the summer season, when field work was in progress. I wish to express my sincere appreciation of the earnest and helpful efforts of all assistants, and especially to Mr. Corwin for his careful and industrious work upon the ponds and alewife fishery.

Laboratories. — During 1912 the Wellfleet laboratory was the headquarters for the pond and mollusk work. The men in the field shipped

their specimens and towings to the laboratory, where these samples were examined and recorded. This laboratory has been mentioned in previous reports and does not require further description. It was not used during 1913, and in the spring of 1914 was dismantled.

In 1913 a small laboratory was built at the Sutton hatchery for investigations upon the diseases of fish and game birds. During 1913 this laboratory was in charge of Arthur B. Merriam. The laboratory consisted of a room, 13 by 15 feet, in a small building on the hatchery grounds. It was fitted with tables and benches for microscopic work, and furnished with good light through eight small windows on three sides. A high table in the center of the room, with space for drawers and closets below, made an excellent dissecting table, while a sink with running water and extensive shelving were conveniently situated. Electric light and power were obtained from the car line near the hatchery. The laboratory equipment, in addition to the usual microscopical outfit, consisted of an Arnold steam sterilizer, a small electric centrifuge, a microtome, a small electric incubator, a hot-air sterilizer, a still, a kerosene stove, and suitable glassware and reagents for ordinary pathological and bacteriological work. In 1914 this laboratory was further stocked with glassware and other material from the Wellfleet laboratory. Work was conducted during part of the summers of 1913 and 1914.

Courtesies. — The commission desires to express its appreciation of the courtesy of the estate of L. D. Baker of Wellfleet in furnishing facilities for laboratory accommodations. The Wellfleet laboratory was situated upon a wharf, the property of the L. D. Baker estate, and all possible opportunities were afforded the commission to carry on investigations upon the shellfisheries and other salt and fresh water fisheries.

This department is likewise under obligation to the United States Bureau of Fisheries for the excellent laboratory facilities afforded to the members of the biological staff during the summers of 1913 and 1914 at Woods Hole. Not only were laboratory facilities provided by Commissioner Hugh M. Smith, but the use of various boats and equipment was placed at the disposal of our department. Without the assistance and help of the men at the Woods Hole laboratory the work of carrying on the investigation of the Buzzards Bay fisheries would have been severely handicapped.

Mollusk Fisheries. — As described in previous reports, the experiments upon clam culture were chiefly carried on between the years 1906 and 1912. During the years 1912, 1913 and 1914 various observations were made upon the different economic mollusk fisheries, and to some extent records were kept of the abundance of mollusks in certain localities. Two lines of work were followed during 1912: —

1. The identification of the different larval mollusks in the towings was continued, as in previous years, making the sixth year that the differentiation of the various species of larval shellfish has been carried on.

2. Growth and cultural experiments upon the soft clam (*Mya arenaria*)

were conducted at Wellfleet and other places, while observations were made upon the clam farms of enterprising culturists at Barnstable, Plymouth, Essex and Wellfleet, in order to note with what degree of success practical clam culture was achieved. In the majority of cases the results of our preliminary experiments were corroborated.

Pond Work. — During the year 1912 the investigation of the fresh-water ponds was continued in the same manner as outlined in the report for 1911, which described in detail the manner in which the survey was conducted. Therefore it is only necessary to state that the general survey of ponds continued for a second summer, principally in Bristol, Norfolk, Essex, Middlesex, Worcester, Plymouth, Hampshire, Hampden and Franklin counties. At the end of the summer, practically 800 ponds, over 20 acres in area, had been examined, although a number proved to be artificial, and therefore not State ponds. The work on the "type" ponds was likewise continued. During the summer of 1913 the systematic survey of State ponds was finished, and for the first time the Commonwealth had a complete description of its inland waters to serve as a basis for future development.

Brooks. — In 1914 an endeavor was made to catalogue the streams of the Commonwealth, classifying them as suitable and unsuitable for stocking with trout and other fish. Since it was impossible to make a personal examination of every stream, the services of the deputy fish and game commissioners were enlisted to look up certain facts concerning the streams in their districts, and to report to the biologist, who then recorded the natural conditions of these streams in two forms, so that by cross references the essential facts concerning any stream could be readily accessible.

1. The streams were arranged alphabetically in a card catalogue system for ready reference, each brook having two cards, one giving a description of the natural conditions, the other containing records of the stocking with various kinds of fish since 1901.

2. The other method was recording by river systems; for example, all streams flowing into the Housatonic being arranged in proper order under that river system. A general description of the Housatonic, with records of its pollution (from the cases examined by this department), was followed by an account of the various tributaries, beginning with the headwaters. By inserting the various tributary ponds the entire water system of the Commonwealth was described. It is hoped that later a more detailed study of the pollution of the larger rivers and streams can be made, with the idea of eliminating all unnecessary pollution.

The Fisheries of Buzzards Bay. — During the summers of 1913 and 1914, in accordance with chapter 104 of the Acts of 1913 and chapter 44 of the Acts of 1914, an investigation was conducted upon the fisheries of Buzzards Bay, with particular reference to the quantities and species of edible and nonedible fish, and to the effect of the present laws and restrictions in respect to taking these fish.

The Alewife Fishery. — Among the most popular of the fishes of New

England is the alewife or branch herring (*Pomolobus pseudoharengus*), which ascends the coastal streams each spring to spawn. Colonial records mention this fish as providing food for the early inhabitants. It has always been highly prized by the shore towns, and the fishery has been maintained for the public benefit. The alewife is of value not alone for food and bait, but its presence, especially the young, at the mouths of the tidal rivers in the late summer, attracts the larger predacious fish to our shores. For this reason the depletion of the supply of alewives has been an important factor in the general decline of the Massachusetts fisheries.

The alewives no longer come to our shores in their former abundance. Rivers which were once frequented by this fish no longer may boast of this fishery, and in nearly all the streams the catch has been seriously impaired. While the chief cause of this decline is undoubtedly excessive destruction of the adults as a result of unwise town control, contributing factors, such as changes in the rivers and streams, which prevent the alewives from reaching their spawning grounds in the fresh-water ponds, pollution, dams, cranberry bogs and other obstructions to the passage of the fish, have brought about this deplorable condition.

In view of the importance of this fishery it was deemed advisable to make a thorough investigation of each alewife stream in the Commonwealth, to determine whether certain beneficial changes in operating the fishery could be instituted. A detailed examination, including the natural and artificial conditions, the present and past methods of fishing and the history of the fishery, has been made; in fact, all information available has been obtained for each stream.

The examination of the various streams and the compilation of data upon the fishery was conducted by Mr. R. S. Corwin and the biologist during 1913, Mr. Corwin personally examining the majority of the streams. Considerable valuable information concerning the restocking of these streams and the future restoration of the fisheries has been compiled.

Bird Diseases. — When game birds are raised on game farms under segregated conditions, diseases of a destructive nature, rarely found in free wild birds, occasionally spread through entire flocks. With the idea of instituting preventive measures, a preliminary study of certain diseases was made at the Sutton hatchery. Merely a general survey of the field has so far been made to serve as a foundation for future work along this line. At the present time there is urgent need for this type of work, since the future of our game farms depends upon the elimination and prevention of destructive bird diseases.

Preliminary Investigations for the Systematic Stocking of Inland Waters.

Introduction. — The selection of suitable waters for stocking fish demands consideration. The general public is not always in absolute sympathy with this part of the work of State commissions. However efficient or capable their personnel, there is bound to be unfavorable and

unjust criticism. Unless a State fish commission has a definite working knowledge of the inland waters, as a basis for methods of distribution, indiscriminate stocking will eventually lead to considerable loss. Extensive hatchery production increases rather than decreases this error, which can be remedied only by a systematic method of stocking based on an accurate knowledge of the waters to be stocked. Under such intelligent and systematic stocking, whereby suitable species and quantities of fish are put into waters adapted for their best development, it is probable that the present production of the inland waters of Massachusetts may be increased by at least tenfold. To accomplish such a result it was necessary to obtain a new perspective, and the preliminary steps which led toward this goal are here described.

Natural Abundance. — Massachusetts possesses many beautiful lakes, ponds and streams, capable of producing an abundance of food and game fish, and in most cases but a few of the many thousand acres of waterways are producing anywhere near their maximum or even normal possibilities. Therefore it is important, both in the interests of sport and as a source of food supply, that these latent assets should be developed for the benefit of the public.

In colonial days, when a relatively small population was scattered along the seacoast, leaving the inland waters in their primitive, uncontaminated condition, the abundance of salt and fresh water fish was far in excess of the needs of the colonists, thus giving rise to the fallacy which has been zealously handed down to the present generation, that "nature would always provide an abundance of fish." Even in this era of conservation this mistaken idea is still deeply rooted, especially among the marine fishermen of our shore towns, and it can be corrected only by the lesson taught by complete exhaustion of the natural supply, or by the education of the general public, who are unbiased by special opportunities for personal gain.

Decline. — With the advance of civilization great changes have taken place in our waterways. Many times the balance of nature has been overthrown and a new equilibrium established. With the increase in population, the coastal streams were first invaded; cities were established on the larger rivers, and various manufacturing industries were likewise scattered along the smaller streams. In order to supply water power numerous dams were constructed, in most instances unprovided with suitable fishways, thus preventing the passage of such fish as the salmon, shad, striped bass, alewife, smelt and white perch up the coastal streams to their spawning grounds. In this way the supply of these fish is not only depleted, but the commercial sea fisheries are indirectly affected by the destruction of a food supply which attracted the larger predacious fish to our shores. Manufacturing wastes and sewage, particularly in central Massachusetts, have totally ruined many streams, and have seriously depleted the supply of fish in others by rendering the water unfit for fish life. Numerous legislative measures have been enacted in the

past, but the decline has steadily continued, since these laws were either inadequate, or, as was more often the case, not enforced. Likewise, over-fishing has seriously depleted local supplies, and in Massachusetts has accelerated the general decline which is so marked in the Merrimac, Charles, Taunton and Connecticut rivers.

Development. — Let us consider what has been done in the past by Massachusetts to offset this decline. In the early days, soon after the establishment of the Massachusetts Department of Fisheries and Game in 1866, salmon and shad hatcheries were located on the principal rivers as long as any native fish remained; but during the last twenty years brook trout have formed the main output of the State hatcheries. These fish, reared in variable quantities, were indiscriminately dumped into ponds or streams at the request of individuals, who filled out brief descriptions of the waters in question. Lack of funds made it impossible to examine these waters, and reliance had to be placed on the judgment of unskilled observers. In many instances this hit-or-miss stocking was successful, in others a failure, resulting in financial loss.

The chief objections to indiscriminate stocking may be enumerated as follows: (1) stocking private ponds and streams from which the public are excluded; (2) intentional distribution of fish by the applicant in other waters than called for by the petition; (3) stocking badly polluted streams in which the young fish cannot exist; (4) putting fish into brooks which run dry in summer; (5) introducing fry or small fingerlings into streams containing large numbers of pickerel or other voracious fish, and conversely introducing coarse fish into trout waters; (6) stocking where conditions are unfit for the life and spawning of the particular species, or where there is a deficiency of food; (7) utilizing streams, poor but popular, to the neglect of more suitable waters; (8) lack of systematic stocking and consecutive distribution; (9) financial loss from stocking in unsuitable quantities.

The method of stocking in vogue in Massachusetts until the last few years has been of questionable value, results have been inconsistent, ponds and streams have been stocked with wrong species of fish, and considerable money has been expended without completely satisfactory results. The methods of propagation have not been entirely adequate to offset the increasing causes of decline, such as pollution, dams without fishways, illegal seining, liming and dynamiting. Hand in hand with propagation should go proper restrictive laws, which *must be enforced*.

The benefits derived from the proper development of the inland waters are: (1) increased facilities for sport and recreation; (2) more business from vacationists; (3) a large food supply; (4) new cottages and pleasure resorts upon our inland waters, developing taxable property.

Stocking. — The stocking of inland waters has three essential parts: (1) the rearing of fish at the hatchery, with its expense, labor and numerous attending problems which have caused it to be falsely considered the entire solution of fish propagation; (2) the successful distribution of

the young fish, and the resulting methods for the successful handling of large and small quantities; (3) the selection of the waters into which the fish are to be placed. In this last respect our perspective has been at fault, since, first of all, it is important to obtain a thorough knowledge of the waterways as a ground work upon which to establish an intelligent system of stocking. The need is the same in all States, and the results should approximate those expected in Massachusetts.

Biological Survey. — The first step toward forming a systematic basis for future stocking is a biological survey of the inland waters. A complete biological survey would include a detailed study of each pond or stream, with its intricate correlation of plant and animal life extending not over one year but over several years. With a State commission the extent and thoroughness of such a survey are necessarily limited by expense and practical results. In Massachusetts the following plan of work has been followed in order to obtain the necessary information for practical stocking with the least expenditure of time and money, and for this reason completeness has been sacrificed. Nevertheless, a thorough biological examination of the important waters of any State is of special value when carried on in a systematic way for a series of years, especially when it is connected with experimental work upon fish in type waters.

Three years ago a survey of the inland waters was undertaken to obtain necessary information for systematic stocking. For this work a method of obtaining a knowledge of the ponds and streams at a comparatively slight expense was evolved. The work was divided into four parts, and was carried on during the summer months, when time and funds were available. The first step, a study of the ponds and lakes, was followed by an investigation of the coastal streams up which alewives or branch herring once ran in large numbers. The third step was the classification and description of the smaller brooks and streams, while the fourth, as yet incomplete, comprised a study of the fishing potentialities of the larger rivers, and is intimately connected with that great bugaboo of the anglers, — pollution. The following account is given of the methods of work on each, in order to show how all four form practically a preliminary survey of the inland waters of Massachusetts.

Type Waters. — This preliminary study by no means completes the problem. Succeeding it should come more careful and detailed work, designed to increase ultimately the supply of food and game fish by (1) a study of the food, growth, spawning and habits of the different species of fish inhabiting various waters; (2) the determination of the species best adapted to certain classes of water by an experimental study of type waters. There are, therefore, two parts: first, the preliminary general work, consisting of an extensive biological survey of the waters in regard to their general conditions to form a guide for future stocking, and a classification of these streams and ponds into certain groups, according to the similarity of the natural environment; second, an intensive study of various type waters, representing the groups above mentioned, as regards

the effects of the natural conditions upon fish life. In such bodies of water records of temperatures, amount of food (plankton) and general changes which concern the problem of fish life should be followed for a number of years. The work on these type waters should serve as a basis for interpreting the conditions in other waters of similar nature.

Ponds. — The Massachusetts law provides only for stocking natural ponds over 20 acres in area, excluding all artificial ones. For this reason the survey was limited to the natural ponds over 20 acres, in all about 800. These ponds were examined personally by a representative of the commission, and a rapid but comprehensive survey was made. This work was carried on during three summer months for two years by four biological students. The entire cost was less than \$2,000, the greater part of the expenses arising from traveling, owing to the inaccessibility of many ponds. Each man examined approximately 100 ponds in seventy-five days, an average of $1\frac{1}{3}$ ponds per day. The size and importance of the body of water made considerable difference in the amount of time devoted to the examination, the small and less important receiving a rapid survey. At best the examination was hurried and superficial, but it achieved the practical object of providing an inventory of the State ponds, and an available working knowledge of the various bodies of waters.

The field equipment of the surveyors consisted of a rucksack, a net of silk bolting cloth for towings, hand lens, bottles, vials, formaldehyde, maximum and minimum thermometer, sounding lines and lead, and record blanks. Reports were written approximately at two-week intervals, while the towings and other material were sent to the central laboratory for microscopical examination. As light an equipment as possible was given the field worker, since, in many cases, he had to traverse the territory between one pond and the next by walking. Numerous difficulties, such as lack of boats, inability to find the ponds, changes in the maps and lack of transportation facilities, retarded the work.

Certain ponds in various parts of the State, from Berkshire to Barnstable counties, were selected for type study. The other ponds of the State were placed in these representative classes, each pond falling into the group for which its environment was best adapted. The types under observation were large and small ponds, both deep and shallow, in which the conditions, as regards the species, growth and abundance of fish, were quite different. From the study of the type ponds, and from a classification of the surveyed ponds, practical deduction as to the species and amount of fish for the individual ponds of the State could be made.

In the survey work the following information concerning the physical characteristics of each pond was obtained in order to insure the proper classification for each type.

(1) *Names.* — The name of the pond is a variable and confusing factor. Usually a pond has several names, according to the various maps upon which it is recorded, and often these listed names are unknown in the

immediate vicinity where local titles are in vogue. To facilitate the identification of any body of water for public information or for stocking, the primary essential is the recording of all the names by which the pond is known.

(2) *Location*. — The situation of the pond as to the ease or difficulty of access from railroad stations or nearest villages, as well as the hotel and boating facilities, were recorded for use in future shipment of fry and fingerlings, and as a source of information to fishermen.

(3) *Area*. — No actual survey of the area of the ponds was made, the size being measured from maps or taken from old records.

(4) *Depth and Bottom*. — Soundings were so made that the contour lines, giving the depths, could be charted on diagrams of the ponds, and from these measurements the average and maximum depths were ascertained. The sounding lead was equipped to take samples of the bottom soil, but, unfortunately, on hard or mossy bottom no soil could be gathered by this method, and the nature of the bottom could only be estimated in shallow water from the character of the shores.

(5) *Water*. — The color of the water was listed either as clear, green or brown. The turbidity was expressed in feet, the number representing the distance below the surface at which a white four-inch circular disc would disappear from view. By means of a maximum and minimum thermometer the temperature at the bottom was taken in various parts of the pond to determine the presence of springs. In the deepest part of the pond a series of readings was taken at intervals from $2\frac{1}{2}$ to 5 feet, to determine the thermocline (described by Dr. E. A. Birge of Wisconsin), or point where the temperature drops rapidly. Deep ponds have three layers of water, — a surface layer, in which the temperature to a depth of 15 to 20 feet remains approximately the same as at the surface; a middle layer or thermocline, in which there is a rapid fall; and a bottom layer, of uniformly low temperature. The extent and nature of these three layers, which vary in different ponds and at different seasons of the year, are of importance as regards fish life from the standpoint of food and oxygen.

(6) *Shores*. — The shores around the pond were classified as woodland, the kinds of trees being noted, and fields whether cultivated or uncultivated, such as pasture, meadow and marsh land. The height and slope of the shores and character of the beaches were likewise noted. Cottages, hotels, gunning stands, icehouses, etc., were recorded as indicating the popularity of the pond as a pleasure resort.

(7) *Inlets and Outlets*. — The inlets and outlets, with the volume of water, temperature, amount of sediment and pollution, such as manufacturing waste or sewage, were described. The presence of a dam at the outlet indicated that the pond either had been raised above its original area or that it was wholly artificial. In certain instances it was practically impossible to determine definitely whether a pond thus raised was originally a State pond.

(8) *Fish*. — Information concerning the different species of fish was

obtained from fishermen and people living in the immediate vicinity who were acquainted with the pond. In the rapid survey it was manifestly impossible to obtain this information in any other way, and for this reason the question of the quality of the fish and the present production of any pond were determined only in a very general way, as the term "good fishing" is but relative, varying with locality.

(9) *Fish Food*. — The study of fish food was undertaken in two ways: (1) the examination of stomach contents of various species, both of the small and the large fish, under various conditions and at different seasons; (2) the determination of the character and amount of the floating organisms (plankton) in the different ponds, by means of a silk bolting cloth net.

Coastal Streams. — The second step was a survey of the coastal streams in connection with the alewife or branch herring fishery. Formerly the alewives ran up these streams and their tributaries to spawn in the fresh-water ponds. In this work the coastal streams and their tributaries were examined by a representative of the State commission. Every dam, obstruction, fishway, cranberry bog, mill or possible source of pollution was accurately charted and described. The physical characteristics of the streams and the animal and plant life were recorded. The method of catching the alewives, the history of the fishery from old records and the possibilities of restocking were studied for the purpose of formulating proper measures for the development of this fishery.

Inland Streams. — The third step in the survey of the inland waters comprised a record of the smaller streams. It was manifestly impossible, from the standpoint of time and expense, for any one man, or even several men, to attempt to examine personally a large number of brooks. The solution of the problem was achieved by enlisting the services of the various State fish and game wardens, each covering a district with which he was thoroughly familiar in regard to the streams. The employment of these men, for the most part not trained scientists, necessitated simplifying the examination, but from a practical standpoint the warden could find out many points concerning the various brooks in his district even if he were not familiar with them from past experience. Many of the wardens had been located for years in their districts, and in the course of their duties had become familiar with most of the streams.

Each warden was given typewritten instructions as to the desired information, and the manner in which he could co-operate was explained by a personal interview. The warden, in connection with his regular duties, gradually accumulated the necessary data, and after several months was able to describe, with the aid of a map, every stream in his district. Naturally more information was available upon some brooks than on others, as certain wardens showed greater aptitude in the work. In addition, many important facts were obtained from local rod and gun clubs.

The information thus obtained was systematized and recorded in the form of a card catalogue (8 by 6 inch cards) in which the names of the brooks were arranged alphabetically. Each stream had two cards, —

one, a record of the various fish with which it had been stocked; the other, a typewritten description comprising the information obtained from the wardens.

Information upon each brook was compiled on the following plan:—

1. The collection of all names, general and local, under which the brook is known is essential for reference in locating petitions for stocking and requests for information.

2. The location of the brook by towns or sections of a town is necessary for identification, as two brooks with the same name may often be found in the same town. The brook is then charted properly and named on the United States Geological Survey maps, which are cut into small numbered maps of a suitable size for filing with the cards.

3. The source, whether in spring, swamp, bog, pond or elsewhere, is noted; likewise into what body of water the brook flows.

4. The length and direction of the courses; the width and depth of the streams at certain places along their courses; the character of the land through which they flow, *e.g.*, meadow, tilled land, pasture, swamp, hardwood, etc.; the rate of flow, volume and clearness of water, the presence of springs and the character of the bed are obtained.

5. The abundance or scarcity of vegetation, with the names of the various water weeds known to the examiner, is desirable.

6. The nature and character of any pollution, whether sewage, sawdust or manufacturing wastes, and a description of the source of this material, are recorded.

7. It is important to know whether the land bordering the brook is posted and the public denied the right of fishing, as no private brook may be stocked by the State.

8. Information as to whether the stream dries up during the summer is an important consideration in stocking.

9. Species of fish in the brook, the results from time of past stocking, if any, and the popularity of the stream with fishermen should be considered.

10. The opinion of the warden as to whether the brook is worth stocking, with what kind and size of fish, and what places afford the most desirable points to liberate the fish, are desirable facts to have on record.

These records, it is true, show frequent errors, and in many particulars are incomplete, owing to lack of information on certain streams, but these gaps can be filled in the future, since each warden is supplied with duplicate records in order that he may correct or add to the information at hand. In this way he will know exactly the information on file at the central office, and can receive shipments of fish or definite orders without mistakes arising from a confusion of names. It is believed that the compilation of these records will be a great aid to Massachusetts in carrying forward a definite and intelligent policy of stocking. Not only will the State department be in a position to dispense information to numerous fishermen, but it can readily classify the petitions for stocking.

The program for the future considers a broader application than a mere bureau of knowledge. It aims to utilize this information so that a plan of systematic stocking may be devised whereby the commission no longer will wait, as is now often the case, until a petition for stocking a stream is received, but will know several years ahead just what brooks are to receive their stated allotments of fish. With the proper knowledge at hand, a system of stocking may be devised whereby the results may be followed in different brooks, where the right species and number of fish may be placed in suitable waters, and where every dollar of the State's money will yield its maximum value. When such results are accomplished Massachusetts may well feel justified in increasing the output of the hatcheries to meet a larger demand.

Pollution. — The fourth step will be the examination of the rivers. Since these streams are greatly polluted by sewage and trade wastes this investigation will be confined chiefly to the pollution problem, and an effort will be made to stock with hardy species of fish those streams which have not become veritable sewers. Exactly how this problem will be solved eventually has not yet been determined, but it will be along the line of least resistance, by first eliminating the unnecessary pollution, which can be avoided at a slight expense. By clearing up the single cases of pollution and preventing new sources, part of our streams may be saved. Later, areas of greater pollution may be considered, but the problem is difficult of solution, and may never be solved satisfactorily.

Co-operation. — Great benefit may be derived by a State commission by intelligent co-operation with the various fishing clubs. This statement does not necessarily imply that the State commission should show undue favoritism to any association, or depart from definite and systematic stocking, but a State commission should receive from local societies information concerning the conditions in the various districts, and in turn should be in a position to furnish adequate advice in all efforts for local fishery improvements. It is only through such co-operation that true advance in fish propagation may be made.

Summary. — 1. The need of a new viewpoint in stocking State waters.

2. How the defects of former methods may be remedied by a proper selection of the inland waters, — a problem long considered of minor importance.

3. The necessity of a preliminary survey of State waters as a basis for future stocking.

4. That such a survey has been made at a slight expense and in a relatively short time.

5. That the future development of State waters demands a definite program of systematic stocking.

Respectfully submitted,

DAVID L. BELDING,
Biologist.

GENERAL INFORMATION.

Numerous requests for information as to the stocking of State waters and coverts, the warden service, fish and birds, and other miscellaneous matters are continually being received. The following statements are designed to cover certain inquiries of this kind:—

Fish.

It is unlawful to introduce any species of fish or game into the State without first having obtained permission from the Commissioners on Fisheries and Game.

Application blanks for securing allotments of fish may be secured at the office of the Fish and Game Commission in the State House, from any district deputy commissioner or from any senator or representative. All applications for fish received after March 1 are subject to delay until the following year. All questions in the application should be answered and the blanks properly filled out and endorsed by a senator or representative before being forwarded to the commission.

Brook trout fry are sent out during April and May, and fingerling trout after July 1. Only one lot of fish for each stream, consisting of not more than 500 fingerlings or 2,000 fry for each mile of waterway, will be furnished.

Only public waters will be stocked. This includes great ponds over 20 acres, rivers and brooks in which the public are allowed to fish. Also, artificial ponds to which the public have access may be stocked.

Brook trout fry and small fingerlings should be planted in the headwaters of a stream, in the small rivulets, where they are protected against their enemies. As soon as they become able to protect themselves they work down into the larger streams. When planted in a large stream they become the prey of the larger fish, and very few live to reach maturity.

Bass, perch and pike should be liberated in close proximity to the shores of ponds, where they can find protection and food among the grass, weeds and rocks in the shallow waters.

Fish should be planted as soon as received, and never kept over night in the cans.

In planting trout and salmon care should be taken to avoid

an abrupt change in temperature by gradually exchanging the water in the can for that from the stream or pond to be stocked.

Black bass fingerlings are sent out from the hatcheries from September to November.

Fish hatcheries are located at Palmer, Wilkinsonville, Sandwich and Adams.

The commission furnishes the following species of fish from the State hatcheries:—

Brook trout.	Yellow perch.
Salmon.	White perch.
Small-mouthed black bass.	Wall-eyed pike.
Large-mouthed black bass.	

Persons desiring to stock private streams or ponds may procure fish from any of the following private commercial hatcheries:—

Plymouth Rock Trout Company, Plymouth, Mass.
 Brookdale and Furnace Brook Trout Hatcheries, Kingston, Mass.
 Hoxie Trout Streams, Plymouth, Mass.
 Jacob Deigle, Agawam, Mass.
 A. R. Graham & Sons, Berkley, Taunton, Mass., R. F. D.
 H. F. Hurlburt, East Freetown, Mass.
 Charles R. Doten, Chiltonville, Mass.
 Bayside Trout Farm, East Wareham, Mass.
 J. A. Scully, Hartsville, Mass.
 Henry W. Beaman (small-mouthed black bass), New Preston, Conn.

Game.

The commission supplies pheasants, quail, mallard ducks, black ducks and wood ducks for the coverts of the State. Pheasant eggs are shipped during May and June, and the birds during July, August and September. With the eggs and birds are sent instructions for hatching and rearing.

Persons interested in fish and game propagation are invited to visit the State hatcheries and game farms, where the superintendents are ready to impart practical information on fish culture and bird rearing.

Game farms are located at Wilkinsonville, Wilbraham, Sharon, Sandwich, Martha's Vineyard and Norfolk.

Laws.

All violations of the fish and game laws should be at once reported to the warden of the district in which the violation occurs or to the office of the commissioners at the State House in Boston.

Books on Fishing and Fish Culture.

1. The Book of Fish and Fishing, by Louis Rhead, Charles Scribner's Sons, New York City.

2. The Fisherman's Friend, Knowlton & Muller, Eagle Building, Brooklyn, N. Y.

3. Fishways, by H. von Bayer, Bulletin United States Bureau of Fisheries, Vol. XXVIII., pp. 1047-1057, illustrated, 1910.

4. Manual of Fish Culture, revised edition, issued by the United States Bureau of Fisheries. Out of print, but possibly may be had in report of that Bureau for 1897, from Superintendent of Documents, Capitol, Washington, D. C.

5. Domesticated Trout, by Livingston Stone.

6. Fish Hatching and Fish Catching, by Green & Roosevelt. Out of print, but may be obtained in second-hand book stores.

7. Modern Fish Culture, by Fred Mather, published by Forest and Stream Publishing Company, 127 Franklin Street, New York.

8. The Cod Fish and its Culture, by Hugo Mulertt. To be had at 289 Fenimore Street, Brooklyn, N. Y.

9. Japanese Goldfish, their Varieties and Cultivation, by Dr. Hugh M. Smith, Commissioner, Bureau of Fisheries, Washington, D. C., W. F. Roberts Company, publishers. 1909.

10. The Home Aquarium, by Eugene Smith, E. P. Dutton & Co., 31 West 23d Street, New York City.

11. Aquatic Plants in Pond Culture, by John W. Titcomb, United States Bureau of Fisheries, Document No. 643, 1909.

Books on Birds.

Native Game Birds, Edward H. Forbush, Massachusetts Board of Agriculture, State House.

Useful Birds, Edward H. Forbush, Massachusetts Board of Agriculture, State House.

American Game Birds, George Bird Grinnell, New York.

